1961-63

CAREERS IN ENGINEERING

UNIVERSITY OF ILLINOIS BULLETIN

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URBANA, ILLINOIS

UNIVERSITY OF ILLINOIS BULLETIN

Vol. 59, No. 10; September, 1961. Published nine times each month by the University of Illinois. Entered as second-class matter December '1, 1912, at the post office at Urbana, Illinois, under the Act of August 24, 1912. Office of Publication, 49 Administration Building (West), Urbana, Illinois.

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CAREERS IN ENGINEERING

A GUIDANCE PUBLICATION FROM THE COLLEGE OF ENGINEERING
AT THE UNIVERSITY OF ILLINOIS, URBANA

Prepared by the Committee on Careers in Engineering

Previous Editions — 1949, 1951, 1952, 1954, 1957, and 1959

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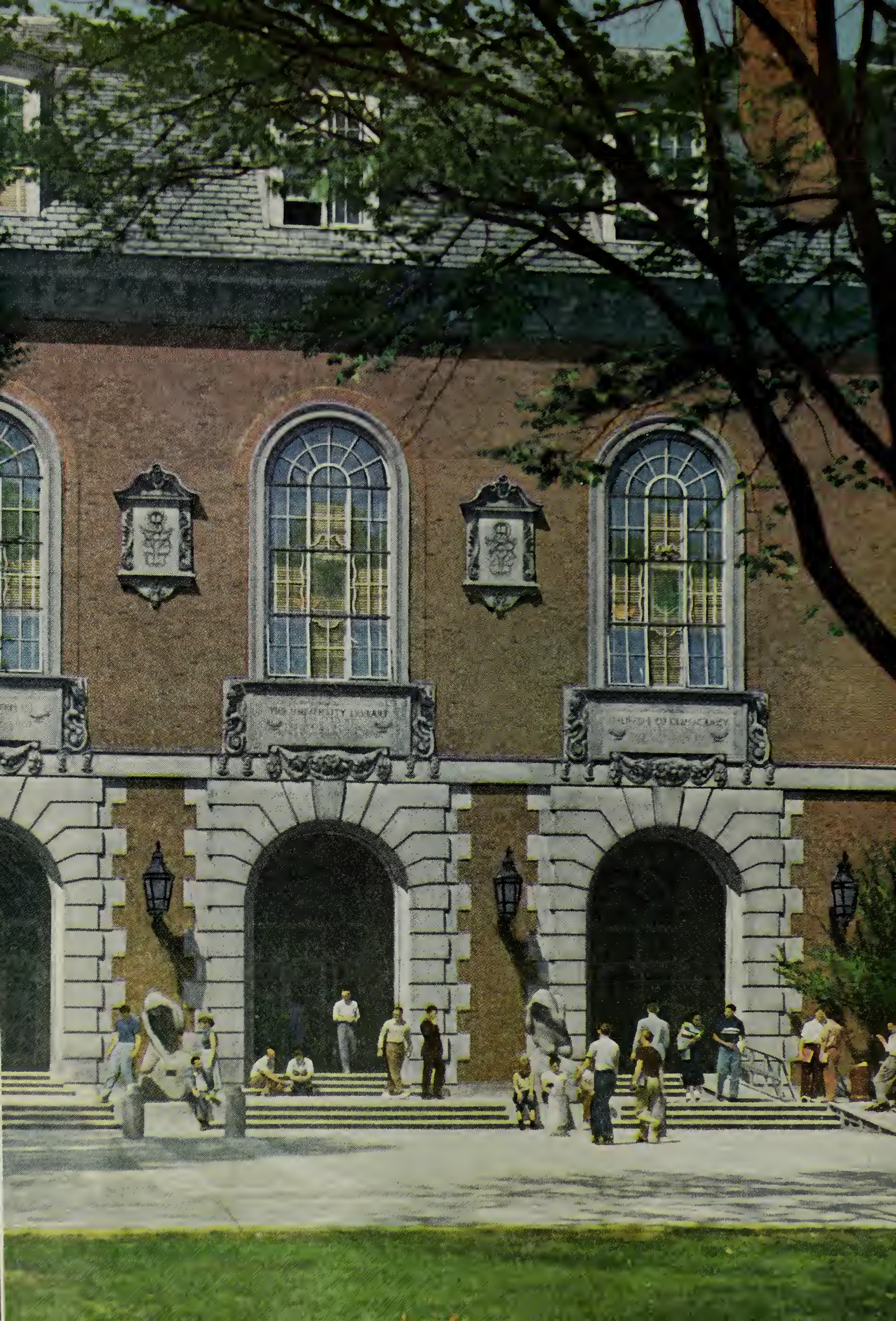
PART I CAREERS IN ENGINEERING



I. CHOOSE YOUR CAREER CAREFULLY

You have reached the point where it is appropriate to choose a career. This booklet tries to help you do so. Most of it is for those of you who find yourselves drawn to engineering. But this first chapter will prove useful to everyone who is giving serious thought to his life's work, whether that turns out to be engineering, business, farming, medicine, law, or any one of a hundred occupations.

Selecting a career isn't an afternoon's task. But if you go at it systematically, you should end with a wise choice. Here is one approach that works for many people:

1. Make a list of the careers you're interested in.
2. Analyze yourself.
3. Analyze the careers you've listed.
4. Compare the results of each career analysis with your self-analysis, to see what fields of work seem to suit you.
5. From among the careers left on your list, choose the one that interests you the most.

When you take the first of these steps — listing careers — forget everything except what appeals to you. However, if you have put down only three or four fields of work, check other careers that you now know little about. You will find additional interests. Add these to your list.

Then analyze yourself. List the things you like and the things you dislike. List your physical skills and handicaps. Look squarely into your mind, and list what it can do well and what it does poorly. In short, try to see yourself as you really are.

Most of us find it hard to size ourselves up this honestly. So, to do the job for us, there are available several kinds of testing and guidance groups. Some are commercial. Some are in high schools. Another is the University of Illinois Student Counseling Service; it operates at both the Urbana-Champaign campus and the Chicago Undergraduate Division (Navy Pier). You can use this service without charge if you plan to attend the University of Illinois.

Now for the third part of your job — analyzing the careers that seem desirable in view of what you yourself are like. Make this analysis in

whatever way the sources of information that you can use will allow. You may wish to start by using your public library, which contains material on many careers. Or you may prefer to postpone library study till after you have talked to men and women who hold the kinds of jobs you're interested in. Most of these people will be glad to tell you what they do and how they were trained. You may arrange to visit industrial plants, construction jobs, business offices, and testing or research laboratories. You can get further facts from universities, colleges, and professional and trade organizations.

Of course, weigh what you are told. You may meet prejudice or error. Any book or person or group which advises you to forget about a given field because it is overcrowded, or to enter it because of its "outstanding opportunities" may be biased or soon out of date. Crowdedness or opportunities can change quickly. What's more, if your self-analysis shows that you have a good mind, you can succeed, no matter how stiff the competition may be.

What data should you gather? Here is a list that you can adapt to suit your own purposes:

1. Types of positions available in the field. In general, each main career — engineering, law, journalism, agriculture, and so on — can be analyzed by the use of one or more of the systems of classification given later.

2. Education requirements — especially the mental and manual skills demanded by the career and by the positions within it.

3. The personality of successful men and women in the career you're studying. Like your own personality, this is hard to get at. But try, because a knowledge of this factor helps to show whether you are likely to be happy in a particular career or occupation.

4. Types of industries and organizations offering employment.

5. Number of people in the career or any main responsibility within it. This figure gives a rough idea of the amount of competition you can expect. Obtain information that's up to the minute. In fact, seek forecasts covering the first few years after you go on the job; but remember that no predictions can be counted on absolutely.

6. Social prestige of the career or position. This is to be considered, but don't let it weigh too heavily.

7. Pay — average salaries, and also lowest and highest. Take into account that total pay includes more than cash pay. It even includes such intangibles as personal satisfaction.

Next compare the analysis of each career or job with the analysis of yourself.

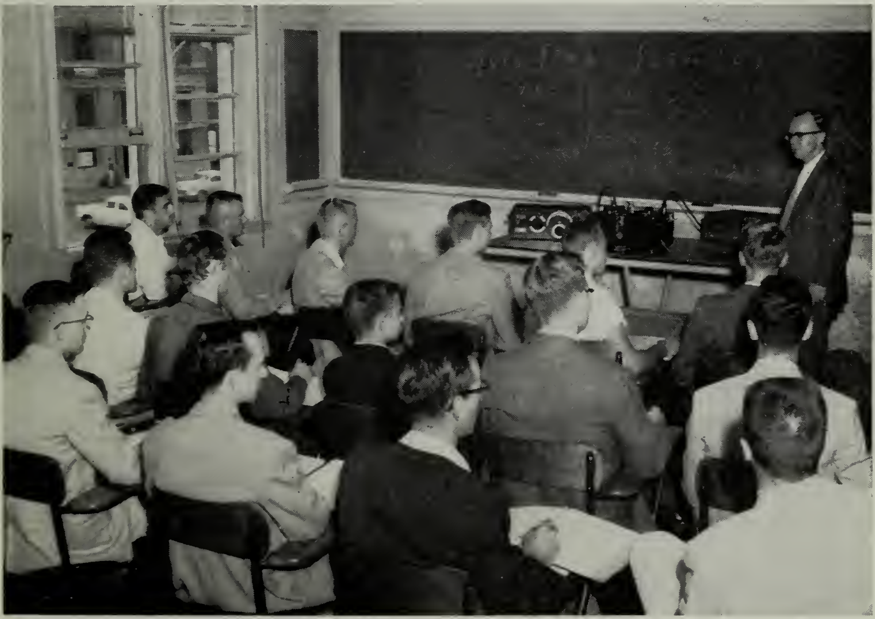
The first result of this comparison may be a feeling that no one career

suits you exactly. Along with this may come the feeling that any one of three or four careers comes close to fitting you. Regard these reactions as normal. They shouldn't discourage you. They should simply lead you to analyze the career, and yourself, more fully.

Then take time to decide. Don't rush. However, it is wise to do your self-analysis no later than the end of your sophomore year in high school. The freshman year or the year preceding it is even better. Here is the reason: Most engineering colleges require a great deal of high school mathematics. So, if you think you might want to become an engineer, you should try as early as the eighth or ninth grade to size up yourself and your prospects and should choose your high school subjects accordingly.

Many students ask, "Should I go a step further? Should I decide, before I enter college, what particular branch of engineering (or law or journalism or medicine or business) I want to go into?" The answer is no. While it may help to settle this question early, you don't have to. Most college courses are not highly specialized until the junior year. This means that you can wait until you get into college before you choose a specialty within your major field of work, though you may be asked to state a preliminary choice for classification purposes.

Even in large departments, such as electrical engineering, classes are kept small and instruction is given by mature and experienced professors.



II. WHAT YOU NEED TO KNOW ABOUT ENGINEERING

WHAT IS ENGINEERING?

You can find a dozen definitions of engineering, depending upon the specific problem at hand. A usable one, however, is *"Engineering represents the art and science by which the properties of matter and the sources of power in nature are made useful to man in structures, machines, and manufactured products."* An engineer, then, is a creative professional man specifically trained and experienced in the use of materials, energy, ideas and communication, men, and money so that these resources are put to the service of mankind.

The "professional" part of this specification means not only completion of a given college curriculum in engineering and science, but also the requirement of willingness and obligation to be held responsible by the public for his creations, often with a prerequisite of examinations and a license to practice. Thus the professional man must have advanced knowledge and education, uses discretion and judgment rather than routine or repetitive techniques, and approaches problems which are varied and intellectual in character, demanding the use of fundamental scientific principles for their solution and a high standard of ethics in their application.

People sometimes have difficulty identifying professional engineers because many projects also require the services of two other groups, technicians and skilled artisans, both of whom are important to the success of the engineering team. Technicians, however, ordinarily have a maximum of two years of technical training rather than a four-year professional college degree or additional graduate degrees. The technician's work often involves repetitive calculations or operations, involving familiarity with equipment and procedures rather than a full understanding of the principles underlying what is done. The artisan, skilled as he is, generally is the product of experience and the apprenticeship system rather than that of formal educational training at the college or technical institute level. The professional engineer, in contrast, must have a knowledge grounded in basic sciences, must exercise initiative and judgment, and bears responsibility to society for his performance.

Just as often, people become confused about the relation between engineers and scientists. Let's see if we can set the matter straight.

Science consists of systematized knowledge of the facts and laws of the physical or material world. Men and women who work professionally with such knowledge are usually called scientists or engineers, depending upon whether their purposes are understanding and the expansion of knowledge for its own sake, or the application of knowledge and principles for the use and benefit of mankind.

The *research scientist* uses existing knowledge in order to gain new knowledge of the material world. He is the man who is commonly referred to as a scientist. Knowledge of the physical world is now so extensive that any one research scientist usually restricts himself to one field, such as physics or chemistry. For him, new knowledge tends to be an end in itself.

The *engineer* is a scientist who uses existing knowledge of the material world for the direct benefit of mankind. He must have imagination so that he can recognize practical values in the discoveries made through research. Then he must have the skill to turn these values into concrete achievements. When the engineer is directly developing new ways of applying the known laws of nature, he is doing *engineering research.*

Engineers and research scientists work cooperatively to benefit mankind. The linkage between the activities of these two types of scientists is so close and strong that we often find it hard to say this man is a scientist, whereas that man is an engineer. In fact, a new group is growing up which has been referred to as "scientist-engineers." Thus a concern with science need not lead you away from engineering.

THE "ENGINEERING METHOD"

No set of brief definitions can give a full picture of what engineering is. The only way to get this broader view is to know how the engineer works. The point is this — the engineer does not merely make the properties of nature useful to man; he does so in a particular way. The method he uses to solve a problem consists of many steps.

Suppose you're an engineer. You've been given, or you've run across, a specific problem that must be solved. What do you do?

First, you study the nature and extent of the problem. You pay special attention to the practical action that will result from your solution.

Next you analyze the problem into its parts. Some of these parts, in turn, will consist of technical problems. Others may consist of problems of dealing with people. Always the financial angle — the cost — will have to be taken into account.

Next you spend a lot of time and thought in trying to determine all of the relationships among the parts into which you have broken the over-all problem. For example, in a heating project you may find that what the average householder wants and what he can afford to buy are

two different things, and you may have to decide whether a compromise is possible, economical, and safe.

In other words, you go beyond listing relationships; you evaluate the factors involved in each part of the over-all problem. You weigh each factor according to its importance, and you discard all factors that you think will not affect the practical solution. After that, you gather all further information you need about the remaining factors. Throughout this stage, you use all the knowledge you have gained or can gain from experience, observation, discussion, reading, experiment, and research.

Now you obtain a solution for each of the parts of your original problem.

The next thing you do is to bring these partial solutions together and see if they add up to a solution for the total problem you started with.

But you realize that you're not through. If time permits, you re-examine the problem to find a still better solution. Many problems in engineering involve data that you can not get in precise quantitative form within the time you have available. So you frequently can not obtain a unique answer like that which can be derived from many purely mathematical problems. There may be several possible solutions. You must use your keenest judgment in choosing the one which seems best in view of all the circumstances and all the factors.

It is clear that the engineer not only thinks analytically. In addition, he works systematically and creatively to find an answer — to synthesize a new form.

WHAT KIND OF PERSON IS AN ENGINEER?

Whenever you try to list the personal characteristics needed in engineering, you meet the problem: What is a "typical" or "average" engineer? Some guidance organizations will give you tests to determine your "personality profile" and will compare it to that of an "average engineer." Of course, though there are characteristics in common, there is no average engineer; as you will see from the classifications of engineering work, two engineers may be performing duties which can no more be compared to each other than surgery can be compared to farming.

Though there is no average engineer, yet the engineer must share with successful men in any profession such characteristics as these — a willingness to work hard; the capacity to assume leadership; the ability to cooperate with others; the hardihood to persist and endure; and an abiding honesty in thought when dealing with facts and in action when dealing with men.

Besides these general character traits, he must possess at least half a dozen more specific ones:

1. A curiosity about and an interest in natural phenomena.
2. The ability to think logically.
3. A positive interest in mathematical analysis.
4. The ability to set up mental pictures.
5. The skill necessary to create ideas and to devise ingenious equipment.
6. The ability to weigh ideas and make wise decisions, often when the data are incomplete — in other words, good judgment.

This doesn't mean that every good engineer has to possess every one of these traits in great measure. And it certainly doesn't mean that he needs to possess no others. But it does give a general idea of what you need for success in most engineering work.

KINDS OF ENGINEERING POSITIONS

As you have seen, success in the engineering profession requires not only that you have certain personal characteristics which are common to all members of the profession, but also that you either have or develop additional traits which will be determined by the nature of the job you enter. This brings us to the problem of classifying and describing various types of engineering jobs. To give you an idea of the relationship among

Two engineering sophomores are shown in general physics laboratory, determining the relation between the charge and mass of an electron by measuring the deflection effects of electric and magnetic fields on a beam of electrons in a vacuum tube.

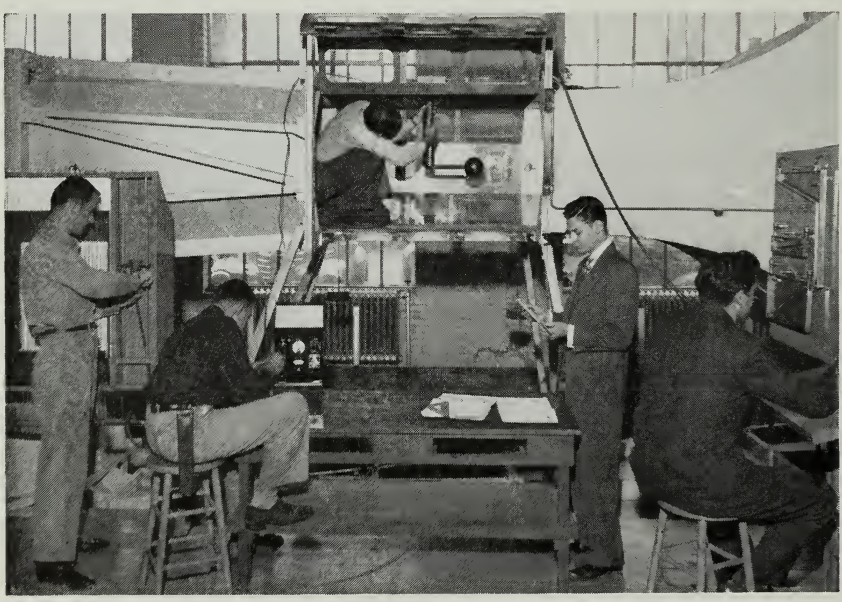
the engineering jobs, our presentation consists of three related methods of classification:

1. According to the main branches which are recognized in industry: aeronautical, agricultural, architectural, ceramic, chemical, civil, electrical, engineering mechanics, engineering physics, general engineering, industrial, marine, mechanical, metallurgical, mining, nuclear, petroleum, and sanitary.
2. On the basis of the functions of the various jobs performed by engineers regardless of what branch they're in: operating, construction, service, sales, application, test, production, design, development, research, and teaching.
3. On the basis of the degrees of responsibility which can be associated with most of the jobs classified by the first two methods: engineer-in-training, technical, supervisory, administrative.

THE MAIN BRANCHES OF ENGINEERING

Engineering once dealt only with the construction of roads, bridges, forts, and other structures for military purposes. Later, as the need for nonmilitary installations became evident, a large group of engineers separated from the military to become "civil" engineers. After this, as scientific and technical knowledge grew beyond the capacity of any one man to master, other engineers split off into new branches. In recent

An aeronautical engineering laboratory group prepares for a test with the small wind tunnel.



years, the amount of accumulated technical knowledge has become so great that individual engineers may specialize in even more concentrated areas of knowledge than are represented by the main branches. These subdivisions are listed in the University's bulletin on *Undergraduate Study* as curricular "options." However, the brief descriptions that follow — some of which are based on the list of accredited curricula in the Annual Report of the Engineers' Council for Professional Development — concern only the main branches.

1. *Aeronautical Engineering* involves primarily the application of scientific and engineering principles to the design and development of airframes and aircraft power plants. Broadly speaking, the field may be subdivided into aerodynamics, structures, propulsion, and design. The problems encountered, however, particularly in aerodynamics and structures, frequently are very complex and can not be solved by mathematical methods alone.

Elaborate experimental investigations may be needed to obtain such solutions. Many aeronautical engineers therefore engage in the design and development of equipment such as wind tunnels for experimental work, or are concerned with its operation and the analysis of the data obtained through its use. Other aeronautical engineers help staff the flight research groups which evaluate or improve aircraft or missile designs from analysis of the full-scale flight test results.

Another area in which aeronautical engineers may work involves problems connected with the operation of transport and cargo aircraft, such as engineering maintenance and modifications of existing aircraft to increase safety and performance. Thus, aeronautical engineers are responsible for solving many technical problems encountered in designing aircraft, ranging from the smallest personal airplane to the largest transport, from the slowest liaison craft to the hypersonic missile, and from the present-day helicopter to the spaceship of the future.

2. *Agricultural Engineering* is the branch of the engineering profession which serves agriculture through the application of basic engineering principles to problems encountered in the agricultural industry. These may involve design, development, maintenance, and applications of (1) gasoline, diesel, and electrical farm power units and machinery, (2) farm buildings, (3) equipment for crop processing and handling, such as crop driers and feed grinders or conveyors, and (4) land improvements centered about drainage, irrigation, and erosion control. The agricultural engineer in industry or in public works, with his sound engineering education added to his understanding of and appreciation for the problems of agriculture, is well prepared to apply his knowledge to the solution of engineering problems in agriculture.

Juniors in the civil engineering soil laboratory using a compaction device to determine the effect of moisture on soil density, an important consideration in designing earthworks.

An aeronautical engineering experiment: a Tesla turbine drives an aircraft turbocompressor.

3. *Ceramic Engineering* deals with the scientific and engineering principles involved in the investigation, production, and utilization of nonmetallic minerals. Some of the newer and more spectacular of these are for high-temperature services such as gas-turbine blades, missile shapes, high-capacity brake linings, refractory pipes for pressure-casting of steel, adhesives, electrical insulation for wires, and various combinations of metals and ceramic materials. Emphasis is placed upon the processes and products of manufacture in such industries as glass, porcelain enamels, structural clay, refractory materials, cements, electrical ceramics such as capacitors or thermistors, and abrasives such as high-speed grinding wheels. The ceramic engineer also deals with the planning of plants, machinery, and equipment used in manufacturing ceramic products. He takes basic courses such as chemistry and physics in common with other engineers, plus special topics such as mineralogy and microscopy. Research in the structure of materials, including studies in the solid state, the development of new processes and products, and their application, is becoming an increasingly important part of his work.

4. *Chemical Engineering* involves the development and application of manufacturing processes by which raw materials are changed in chemical composition and physical form to products for industrial and commercial use. The processes by which the physical changes are brought about may be classified into a series of "unit operations" for which the principles are the same in all industries. Chemical engineers are concerned with the control of chemical reactions during the processing to produce the desired product in the most economical way. Some of the industries in which these engineers are employed are oil refining, pulp and paper, plastics, atomic energy, and the manufacture of organic chemicals, heavy chemicals, synthetic fibers, rubber, fertilizers, and pharmaceutical chemicals.

5. *Civil Engineering* represents a broad field which can be divided into four major areas: structural engineering, transportation engineering, sanitary engineering, and hydraulic engineering. Each involves planning, design, construction, and in some cases operation and maintenance.

Civil engineering is keeping pace with the new scientific developments and needs in today's changing world. Structural engineers are participating in the design of rockets, missile and satellite launching platforms, structural parts of airplanes, blast-resistant buildings, and bomb shelters. New high-speed digital computers are being used extensively by civil engineers to do many routine calculations and to make computations that were previously impractical. As a result, time and energy are released for more important phases of their work.

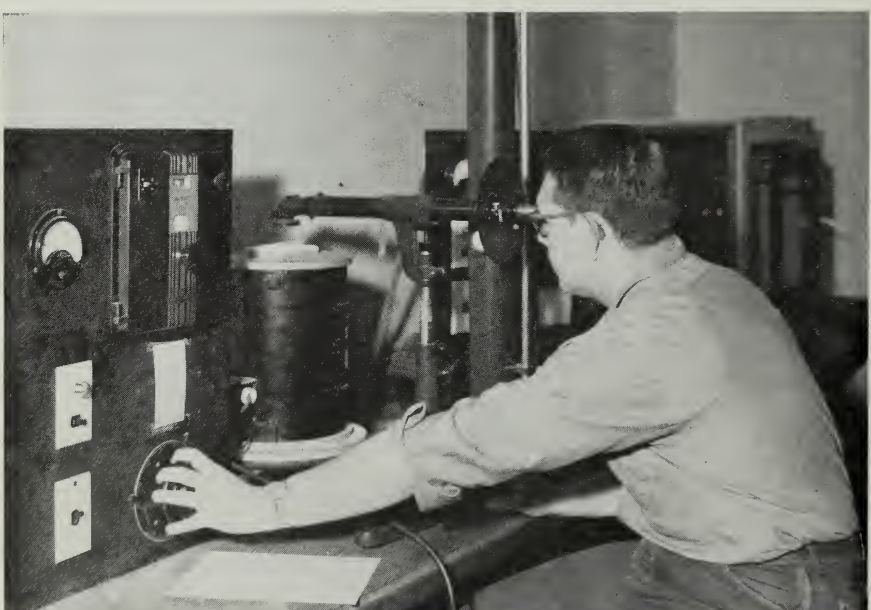
Today's civil engineer makes surveys from the air as well as from the ground. Photogrammetry, the science of making reliable measurements

from aerial photographs, provides rapidly and economically the basic maps needed for planning and designing civil engineering projects. Sanitary engineers are actively engaged in solving the disposal problems arising from the use of radioactive materials in power plants, hospitals, and factories; in the practical conversion of sea water to fresh water; and in the reduction of the atmospheric pollution of many of our cities.

Structural engineering concerns itself with bridges, buildings, dams, retaining walls, tunnels, subways, towers for transmission lines, radio, television, and many other similar problems. The design of such structures involves complex theoretical studies and often the use of high-speed computers. Provision of adequate foundations for above-ground structures is an important consideration, and in recent years has developed a new specialized field of study, known as soil mechanics and foundation engineering.

Transportation engineering concerns itself with the vast networks of highways, railways, waterways, and airfields. The civil engineer is responsible for the design, construction, and maintenance of the highway and railway systems; for the design and construction of harbors and dock facilities, and of inland waterways; and for the runways, control

A student in ceramic engineering uses an optical interferometer to measure the thermal dilatation or change in size of ceramic materials with changes in temperature.



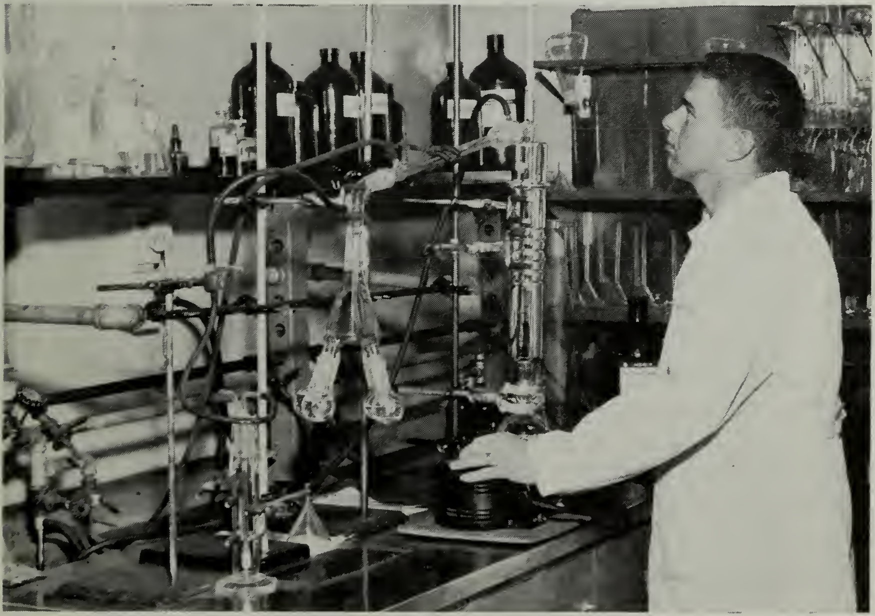
towers, and buildings for airfields. He deals also with the problem of highway traffic control.

Sanitary engineering concerns itself with the development and maintenance of a healthy environment for people. This involves provision of a safe and adequate supply of water for human and industrial uses; determination of the causes and the remedies for air pollution; safeguarding food supplies during preparation and distribution; prevention of industrial diseases and provision of safe and healthful surroundings at work; and finally the safe disposition of waste materials of all kinds.

Hydraulic engineering concerns itself with the control and transportation of fluids. Reservoirs are created by the building of dams to store water for power generation, water supply, flood control, and irrigation needs; power plants are built for the generation of electricity; conduits and canals are constructed to distribute the water for irrigation and water supply purposes. More recently, extensive pipeline systems have been built for the transportation of petroleum and petroleum products, natural gas, and coal in powdered form.

Work in any one of the major subdivisions may involve work in one or more of the others, in some other branch of engineering, or another field of science.

Apparatus for the fractional distillation of organic chemicals being used in a sanitary engineering laboratory to reduce stream pollution by the treatment of petrochemical wastes.



6. *Electrical Engineering* is divided into two main parts. One involves the generation, transmission, and utilization of electrical energy and the other concerns the coding, transmission, and processing of information. The outward appearance of the electrical apparatus (such as generators, television receivers, transmission lines, etc.) associated with these two areas is certainly different and there is, of course, no similarity in the various word explanations of how they operate.

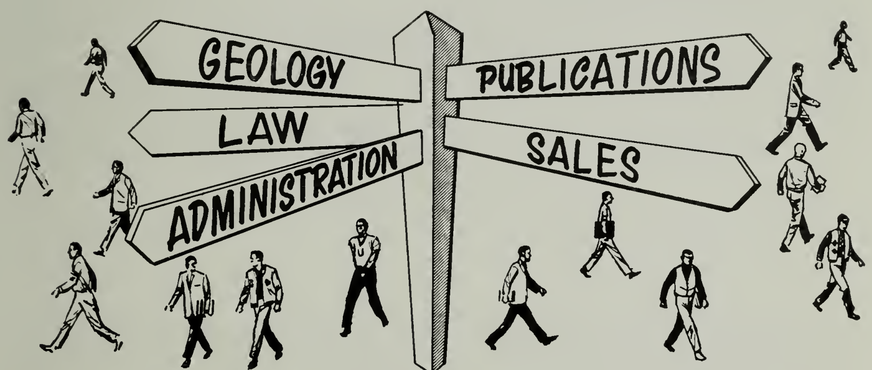
On the other hand, the most fundamental principles of these devices, expressed in mathematical terms, are very similar and closely related. Consequently the Department of Electrical Engineering does not maintain separate divisions or "options" for students to follow. Rather, there is a common program involving these basic principles, which prepares the student for various positions and employment now in existence as well as for responsibilities and problems which will not exist until some future date.

There are many positions in the field of electrical engineering which can be filled only by persons holding advanced degrees. Therefore, superior students usually are encouraged to continue their studies beyond the bachelor's degree. Yet any good student who achieves the bachelor's degree can reasonably expect to receive many offers of interesting and challenging employment with excellent financial rewards.

Latin is said to be the language of law, and drafting the language of architecture. Likewise electrical engineering has a "language." It is mathematics. Virtually all electrical principles are expressed in this medium. A prospective student should carefully evaluate his mathematical aptitude and interest before making the final decision to be an electrical engineer. First-year students in electrical engineering at the University of Illinois are required to make a better than average record in mathematics and physics (3.25 grade point out of 5.0) in order to qualify for the regular electrical engineering program.

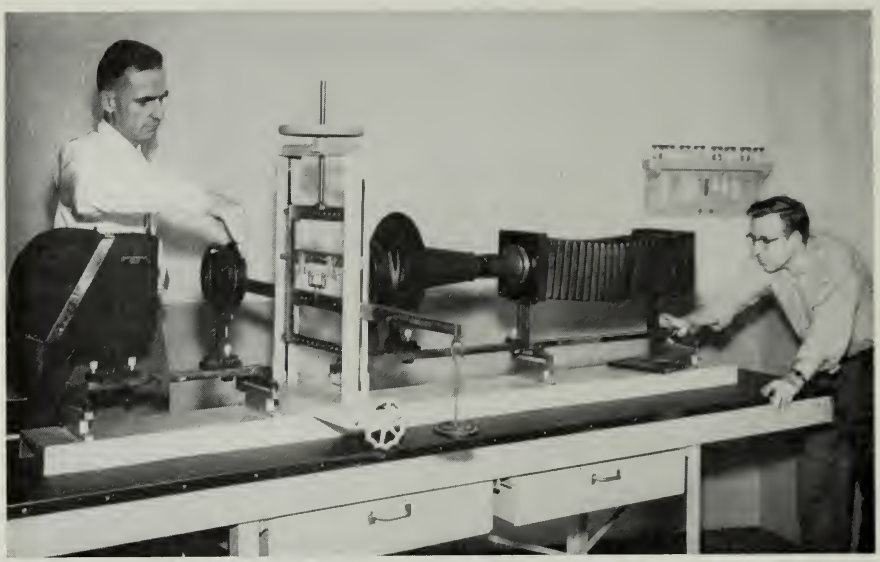
7. *Engineering Mechanics* provides the foundation upon which engineering methods and procedures are based. The principles of mechanics underlie the theories and analyses of structures, fluid flow, the motion of bodies (including aircraft and missiles), and many other important engineering topics. The engineering mechanics curriculum emphasizes the basic sciences: mathematics, physics, and chemistry, as well as the engineering sciences: mechanics of solids, fluid flow, thermodynamics, electrical theory, and the nature and properties of engineering materials. Graduates with a background in mechanics can fit into any industry to solve new problems, work with scientists and engineers from other fields, and are particularly well qualified for careers in research and development as well as for advanced graduate work.

8. *General Engineering* offers a sound education in basic engineering sciences. A wide choice of electives and a flexible program allow the general engineer to prepare himself for a career in engineering administration, in business, engineering sales, engineering geology, engineering publications, or other similar fields. By securing additional legal training, he can also specialize in engineering law. In short, through general engineering the student can pursue a variety of careers somewhat off the beaten paths, but still related to and utilizing engineering and a technical education.

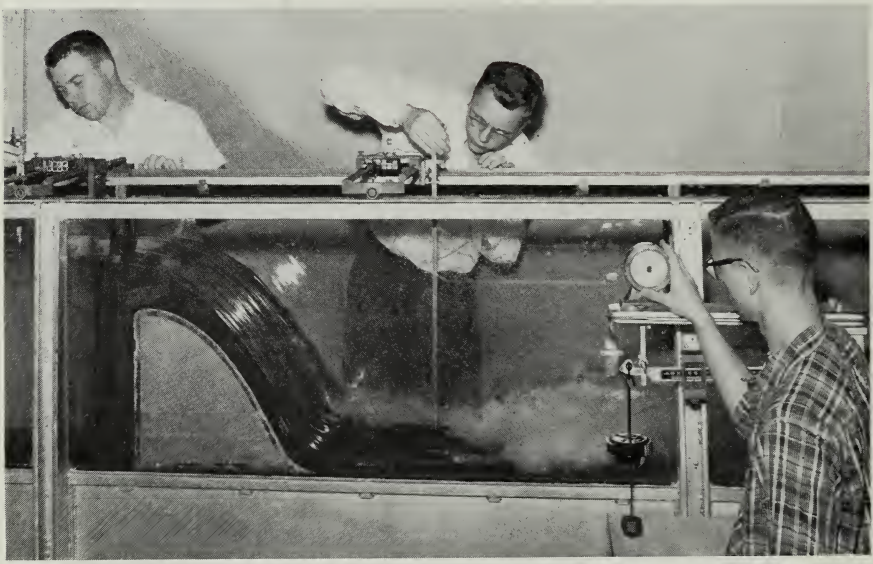


Nontechnical fields of concentration in general engineering.

9. *Industrial Engineering* is concerned essentially with the cost and production of goods according to a strict schedule, while other branches of engineering are concerned primarily with the function and quality of a product. It is a science of planning for manufacture in the same way that the older branches of engineering plan designs. It is concerned with coordinating men, materials, machines, and money to the end that a product of the quality specified by the designer can be produced at a minimum cost, at a time desired by the buyer. It involves planning the organization, analyzing the product in terms of manufacturing procedures, selecting equipment, supplying special tooling, determining the plant layout and materials handling means, establishing work methods and output standards, studying wage payment systems, and setting up methods of quality control. Industrial engineering applies in any field of manufacturing, whether the product is metal, cloth, paper, or plastics.



A polariscope is used in theoretical and applied mechanics experiments to observe and photograph the stress patterns in a plastic model which represents quite accurately the behavior of a full-scale steel plate or structure.



Students conduct a "hydraulic jump" experiment in the fluid mechanics laboratory. Note that the level of low speed water at the right is higher than that of the same quantity of fluid moving at higher speeds below the spillway.

Modern industry is highly mechanized, so that the industrial engineer must be essentially a mechanical engineer with a background in management, economics, and accounting. Because the human element is a major factor affecting his plans, it is also desirable for him to have a good understanding of personnel management, psychology, and sociology.

10. *Mechanical Engineering* deals with the generation and transmission of power, and with the design, construction, operation, and testing of all kinds of machines. Like the civil and electrical engineer, the mechanical engineer performs a great variety of functions. In the transportation field alone he deals with marine, railway, automotive, and aircraft equipment. In other fields his work ranges from machine tools, engines, and turbines to refrigerators, air conditioners, heating and ventilating plants, and nuclear power installations.

11. *Metallurgical Engineering* is primarily distinguished from other fields by its emphasis on materials rather than on machines and structures. A metallurgist, then, has a basic interest in the design, processing, and testing of metallic engineering materials. The metallurgical field can be divided into two broad areas: extractive metallurgy, dealing with separation and purification of metals from their natural states; and physical metallurgy, involving the nature, structure, treatment, and properties of metals and alloys. The metallurgist must study the factors which control the properties of metals, and use this knowledge to provide the right metal processed in the right way to obtain the best performance for any particular application. Thus, the metallurgical engineer is essential to all industries producing metal products or using metals in their manufacturing processes.

12. *Mining Engineering* covers the removal of useful minerals, both metallic and nonmetallic, from the earth's crust; their concentration, cleaning, or other treatment; and their processing into a marketable product. Mining engineers are concerned with finding mineral deposits, such as asbestos, iron ore, coal, or petroleum, exploring the size and evaluating the quality of such beds, determining whether profitable mining is possible, and choosing a method for extracting, recovering, and treating the mineral concerned. Mining engineers also select or design the processing equipment, supervise the erection of the plant, and control the operation of the extraction and treatment facilities. Some mining graduates of course cover the whole range of this kind of activity, while others confine themselves to a single aspect or specialty.

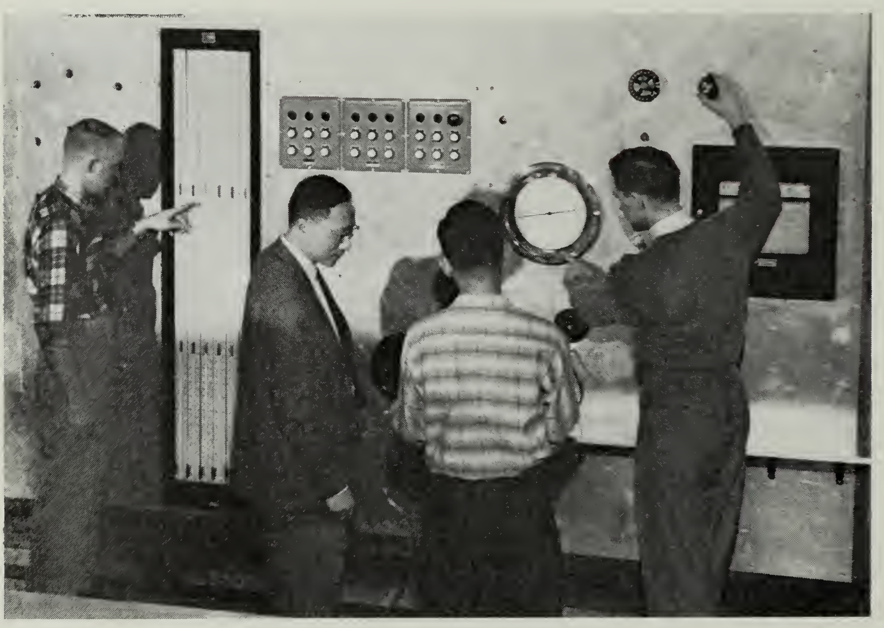
13. *Petroleum Engineering,* a variation of mining engineering, centers around the development and exploitation of oil and natural gas reserves. Before wells are drilled, the petroleum engineer must determine the

optimum well-spacing pattern. He must also consider the preferred order or sequence for exploiting reservoirs adjacent to each other in both horizontal and vertical directions, specify the bore diameter and size reduction with depth, and recommend procedures for setting the casing, excluding extraneous fluids from the well-bore, and stimulating formation yields by acidizing, gun perforating, or fracturing the reservoir rock.

Ultimately, the petroleum engineer must also design the flow tubing and wellhead assemblies; select and lay out the surface plant of oil and gas separators, tank batteries and manifolds, pumping equipment, and pipe-line connections. In the course of this work, he must solve a wide variety of fluid mechanics problems. He must also be cognizant of economic factors, and interested in socio-humanistic considerations, such as those pertaining to the conservation of a wasting natural resource, and to public relations.

Petroleum is an important source of energy. Even after it is replaced by other types, it will always be needed as a lubricant and as a source material for the petrochemical industry. The United States is the major producer and user of petroleum and hydrocarbon products, for which both important sources and markets exist in Illinois. Although the petroleum industry offers positions for engineering and science students in almost all categories (especially mining, mechanical, electrical, and

A group of graduate students and their instructor operating the boiling-water loop.



chemical engineers, and physicists, mathematicians, and geologists), there is a continuing demand for qualified petroleum engineers to carry out special and responsible tasks.

14. *Nuclear Engineering* is concerned with applying to engineering problems the concepts and devices of nuclear physics. The investigation and use of nuclear particles and the reactions between them have constituted a major research activity of modern physics. Begun in the 1930's, this research has led to the chain reaction, the atomic pile, to fission and fusion weapons, and to nuclear power plants. Only a start has been made in forecasting the career potential of this rapidly expanding technological frontier for the young men and women planning to enter college now and in the future.

New types of power reactors must be designed, manufactured, installed, and operated; their adaptation as propulsion devices for submarines, commercial ships, aircraft, and missiles has just begun. The unique problems of nuclear propulsion for the space age are still ahead. Special techniques are needed for the remote handling or manufacturing of radioactive materials, and for the measurement of radiation effects. Development of reactor fuel elements and corrosion-proof systems is proceeding both in government and industrial laboratories.

The use of radioactive isotopes for tracer analysis and the application of radiation sources to aid industrial production through such methods as nondestructive testing, sterilization of foodstuffs, or even the improvement of materials are far from fully exploited. Special problems such as those encountered in the control and disposal of radioactive wastes, and the whole area of safety, both public and private, in the expanding nuclear industry also offer interesting opportunities.

In addition, much remains to be done in the design and use of high-energy particle accelerators for the unexplored ranges up toward a hundred billion electron volts; these basic investigations are of great significance to physicists, and offer possibilities also for engineer-scientists. Finally, in the light of our steadily increasing demands for power, plasma physics and the whole field of controlled fusion pose a continued challenge. Here may lie the most promising social contributions of nuclear science and engineering — development of an unlimited resource to supplement our otherwise rapidly dwindling energy reserves.

Attractive careers in nuclear science and engineering are open to broadly-educated, energetic, imaginative men and women with varied interests. Nuclear engineering as a career requires graduate training. It can be entered through undergraduate preparation in physics, engineering physics, chemistry, or one of the established engineering disci-

plines. With an appropriate background and high academic performance during his college years, a student is very likely to be given financial support for his graduate program, either in the form of fellowships or of teaching and research assistantships.

Nuclear engineering requires the solution of complex problems; success in this field depends upon cooperative effort and effective communication with people. Thus a solid secondary-school background in English, mathematics, and physics is essential. Though this emphasis on basic training and on the fundamental sciences in college may seem a long deferment of specialization, it is realistic in terms both of employment and career demands.

15. *Engineering Physics* is an increasingly important curriculum because of the rapidity with which new discoveries in basic science are being applied to practical problems. This development has in fact produced a new type of engineer, or scientist-engineer, who is in effect a physicist primarily interested in applied problems.

Actually, the stream of current technological progress arises from two main sources: basic science or pure research on the one hand, and practical experience in shop, plant, or test facility on the other. In many fields today, basic science is rapidly becoming the dominant source of engineering progress. Until recently, however, the discoveries of basic science did not enter technology or reach the application stage for a generation or more. As an example, Hertz demonstrated radio waves in the 1880's, but they were not widely used for practical purposes until after 1910.

In contrast, nuclear fission was discovered in the research laboratory in 1939; by 1942 the first atomic pile was operating, and by 1945 the first nuclear bomb had been tested. Similarly, the quantum theory of solids and the research in solid state physics in the middle 1940's led to the widespread use of the transistor, and to a whole series of remarkable new electronic devices within a half-dozen years. Already, radar systems are being equipped with the new "atomic amplifier," known as the "maser," only three or four years after its appearance in the physics research laboratory.

In the future, there is every reason to expect that the applications of scientific discoveries will follow ever more closely upon investigations in the basic research laboratory. In the engineering physics curriculum, therefore, the technical studies consist almost entirely of basic subjects: mathematics, chemistry, classical mechanics, electricity, optics, atomic and nuclear physics, quantum mechanics, thermodynamics, and statistical mechanics. Many students emphasize one of the engineering disciplines by means of elective courses.

With a bachelor's degree, the engineering physicist has many opportunities for employment, but the most exciting prospects await students who have the master's or doctor's degree in physics. With graduate study, the field is almost unlimited: basic research, advanced engineering of almost any type, operations research — all are open to the physicist who holds the doctoral degree.

Today, for example, men trained in basic physics are playing a leading role in the following frontier areas of engineering: Mach 20 aerodynamics, thermonuclear power, the design of nuclear reactors, quantum-electronics, infra-red detection systems, radar, data-processing systems and automatic computers, nuclear and ion-propulsion rocket engines, orbit calculations for space vehicles, high-temperature materials, and geophysical instrumentation. In addition, the applied physicist finds research in physics an accessible field: new particles, cosmic rays, the properties of matter at low and high temperatures, and nuclear physics.

Few engineering curricula can match engineering physics for flexibility in career opportunities at the bachelor's level; it is probably safe to say that none can exceed the wide range of possibilities available to the Ph.D. physicist. Students who have the requisite ability in mathematics and physical theory are, therefore, encouraged to plan for graduate study whenever possible.

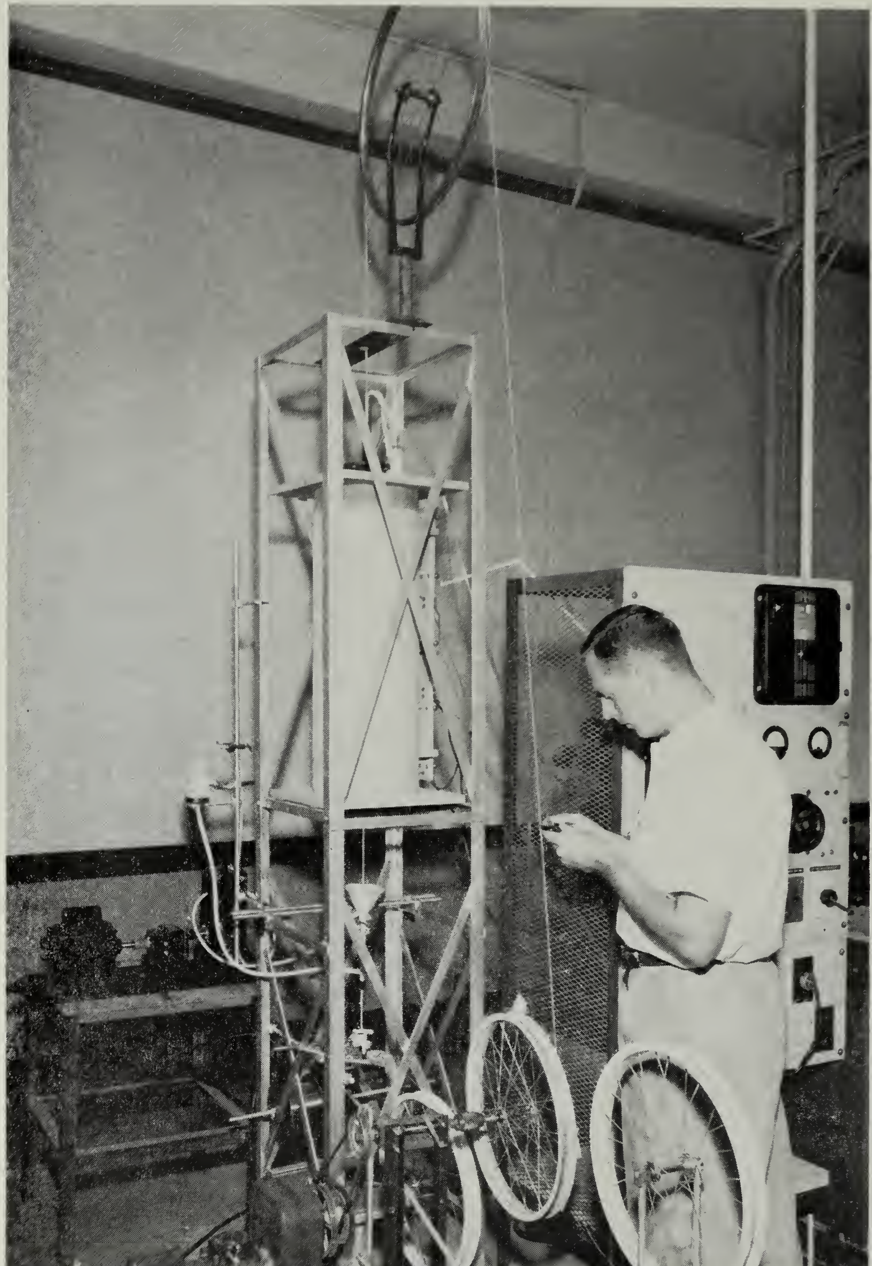
SPECIAL FIELDS

Other branches of engineering are recognized, and in certain parts of the United States they have attained much industrial importance. Examples are geological engineering and textile engineering. Throughout the country, architectural engineering as an offshoot of architecture also plays a considerable role.

ENGINEERING WORK CLASSIFIED BY FUNCTION

The descriptions of the main subject branches give only a general idea of the types of work engineers perform. Typical functions have been cited for each branch, with the understanding that one man is not ordinarily expected to perform all of these functions at once, or often more than one or two at a time. As he gains experience or changes positions, however, an engineer may well perform several functions; to give you a better view of the standard classifications as a group, they are described briefly below.

The sequence is organized, not by importance, but chronologically as a new conception or idea is processed until it has been made useful to man. In addition, at the end of the list, several non-standard functions of importance, including teaching, administration, and publications work, have been added. Though they do not fall into the usual order, in



A research project in ceramic engineering — the development of a new flexible high-temperature-resistant coating which will increase the exposure ability of insulated copper wire. Size and weight will thus be saved in electric motors and other windings, especially for aircraft and missiles.

interest and requirements they rank with research, with planning and production, or with sales. Beginning with discovery, then, engineering functions number something like a dozen.

1. *Research Engineer.* The research engineer's energies are devoted to extending the horizons of knowledge. He must search and study the literature on a particular subject, make calculations to verify theory, and conduct experiments to prove, reject, or modify existing theories. A man engaged in *scientific* research investigates physical laws for the purpose of increasing scientific knowledge, without being particularly concerned about the immediate application of his discoveries. In *engineering* research the aim is to solve specific manufacturing problems, to develop new equipment and materials for which there is a need, and to evaluate theoretical relationships in terms of the actual behavior of materials and engineering structures.

2. *Development Engineer.* The development engineer's function is mainly to take the results and discoveries of research and convert them into useful apparatus, products, or methods. He needs to do a considerable amount of experimental and analytical work in order to get a product or method into final form for production or use.

3. *Design Engineer.* The design engineer is responsible for preparing detailed plans and specifications from which a piece of apparatus is produced or a project is constructed. He makes the necessary calculations and sketches, writes detailed specifications or else supervises the writing, selects needed materials and processes, helps prepare the specifications for test procedure, and establishes acceptable performance standards for the manufacture of equipment or the fabrication of structures. To do this he must be analytically inclined and be able to visualize what happens during the operation of any piece of equipment. He must also keep up to date on the latest developments and on the patent situation in his field.

4. *Production Engineer.* The production engineer is responsible for the manufacture of products and apparatus from raw materials and designs. He analyzes the methods, processes, and equipment used in the manufacturing operation. Giving due consideration to economic factors, he works closely with the design engineer on manufacturing problems. In addition to having a good knowledge of engineering and manufacturing procedures, he must also be informed about the principles of industrial management and the problems of human relations that go with it.

5. *Test Engineer.* A test engineer performs different functions, depending on the branch of engineering in which he is employed. In some cases he is in direct charge of the actual testing of equipment, materials, and

processes, to find out whether they meet specifications and accepted engineering standards. In the cases where the test engineer is associated with the research or development phases of the organization, he is responsible for setting up the test facilities and conducting the tests so that he can verify or disprove the facts to be determined from the tests. The results of calculations from the test data will then provide information from which further modifications or improvements can be made. This type of engineering requires frequent contact with engineers of the research and design groups.

6. *Planning Engineer.* The planning engineer solves plant and system problems. His work involves the selection and combination of equipment or facilities which are best suited to accomplish a required task. To do this, the facilities must meet certain technical standards, provide the proper capacity for the volume of operations involved, and produce satisfactory results at the most reasonable cost. In a manufacturing company the planning engineer, or application engineer as he is sometimes called, also acts as a consultant to the sales organization and helps select the specialized equipment that will best serve the customers' needs. The planning engineer must have a good engineering background, the ability to visualize all aspects of a problem, a well-developed economic sense, and an unusual amount of imagination in order to anticipate developments and needs of the future.

7. *Sales Engineer.* The sales engineer works directly with the customer as the manufacturer's sales and engineering representative. As in any sales work, he needs to study customers' requirements, and to know thoroughly the equipment he is selling, so that he can explain its design, construction, and operating features. Ordinarily he is responsible for arranging the delivery date of the equipment and occasionally for negotiating its price. In addition to technical training, he should have the type of personality which inspires confidence, and the ability to work with people.

8. *Service Engineer.* Men who decide to work as service engineers supervise the installation of new apparatus and perform the final tests. They investigate customer complaints and correct any trouble which the equipment may be giving the customer. In many cases the difficulties may be important enough to require that operations be restored as soon as possible — often under emergency conditions. Because the work covers a broad field in widely varying situations, these men need a good, basic engineering knowledge along with plenty of ingenuity. Because service engineering necessitates dealing with the customer, many companies combine service and sales engineering into a single job.

9. *Construction Engineer.* The construction engineer supervises the construction of facilities and structures from designs and plans, a job which calls for ingenuity in the practical application of physical principles. This work requires familiarity not only with the technical problems as they apply to a particular field but also with the problems specifically associated with all construction work — namely, the procurement of materials, the selection and proper use of equipment, and the handling of men. The ability to work with others and direct their efforts is as important to the construction engineer as is his technical background.

10. *Operating Engineer.* The operating engineer is charged with the responsibility of conducting part or all of an enterprise safely, efficiently, and without interruption. He may work with a group of machines, a plant, or a system. In many companies, he supervises procurement of supplies and repair parts, protection and maintenance of equipment, selection of new equipment, and direction of operating personnel. In case of a breakdown or an emergency he must have the ingenuity and resourcefulness to restore full operation, frequently under the most difficult conditions. Like the construction engineer, he must have a broad engineering background and be able to handle men. He should not be confused with those who perform repetitive tasks in the operation of existing equipment. Such men are not engineers in the professional sense.

11. *Teaching.* In addition to the standard engineering functions listed above, there is increasingly a demand and opportunity for engineering careers in numerous related areas. First of these, perhaps, is the *teaching* of engineering. Second would be the general area of interest including such staff functions as engineering administration, publications engineering, or scientific and technical journalism.

The teaching of engineering, which can readily be combined with university or basic research, requires an interest in ideas and people plus a willingness to help students comprehend and grow in their command of scientific and technical subject matters. This requires a certain facility in explanation on the teacher's part, as well as scholarly interest in advancing knowledge, and enjoyment of students as people.

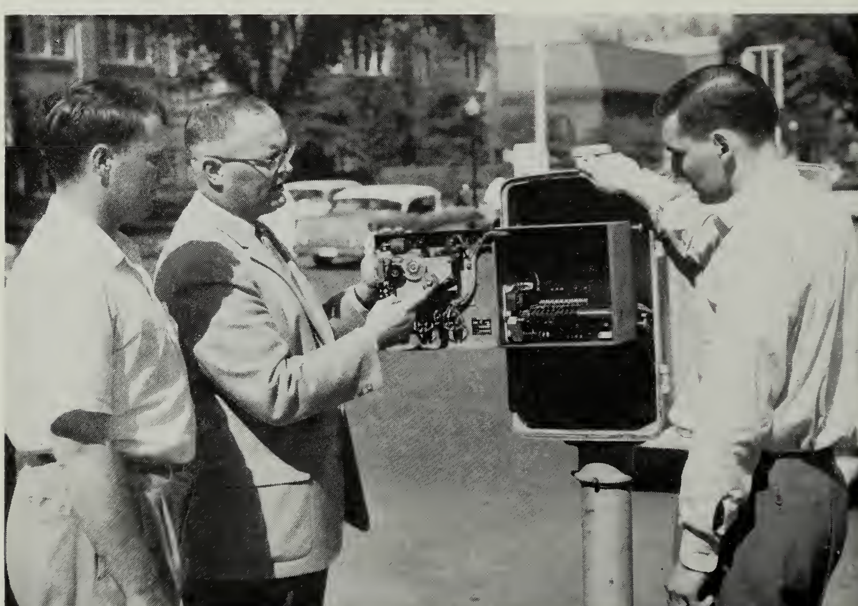
There are undoubted rewards, however, in multiplying one's individual contribution to the profession through the satisfaction of seeing students learn and succeed in engineering practice. Graduate study and the Ph.D. degree are becoming required qualifications to hold teaching positions, but fellowships and assistantships are generally available to make advanced study possible at a minimum cost. All serious students with good class standing should, therefore, consider teaching as a professional career full of satisfaction, and should discuss it with their instructors.

As a career, the promise of teaching should increase steadily. The pressure of expanding student numbers over the next ten years or more should not only increase the demand for teachers in engineering (the latest estimate is that more than twice as many will be needed in ten years), but should improve the prestige, financial rewards, and general attractiveness of such positions as well.

12. *Administration and Publication.* Somewhat the same picture of expanding opportunity holds for engineering administration and publication. Engineering management requires technical interest and competence together with knowledge of the business and personnel aspects of industrial research, production, and distribution. Again, graduate study, usually in business administration or law, or both, is often indicated, but the ability to work successfully with a background in dual fields broadens the scope of application for technical skills.

Publications and allied work requires first the ability to follow technical theory and explanations, then to write or oversee the production of appropriate reports, speeches, manuals, or articles in journals, magazines, or newspapers expressing the ideas concerned. Again, publications and similar work frequently lead rapidly to higher administrative or per-

One phase of civil engineering is the planning and control of traffic movements on highways, including such equipment as the signal-actuating mechanism here being explained to students.



sonnel posts in industry. Many of these positions are somewhat out of the routine line of engineering development, but frequently prove of unusual interest to those with wide-ranging minds. In financial return and advancement the potential rewards are at least equal to those of the routine types of responsibility.

ENGINEERING WORK CLASSIFIED BY LEVEL OF RESPONSIBILITY

The third and final way of classifying engineering work is based on the amount of responsibility required for the job. Again, not every one of the following levels exists for each of the functions just classified.

1. *Work as Engineer-in-Training.* Many young engineers are first classified as trainees. Under the close direction of the organization employing them, they continue their education but focus it sharply upon the demands and procedures of the industry and organization to which they now belong.

2. *Technical Work.* The first type of job a young engineer encounters consists of work at the technical level and demands a minimum of responsibility on his part. He solves technical problems under the general supervision of someone else who determines what problem is to be attacked and when a satisfactory solution has been reached.

3. *Supervisory Work.* The next type of job, which the engineer can attain only after having proven his ability, consists of work at the supervisory level. He assigns problems to other engineers and directs their work. In this capacity he is responsible for the proper operation of a group or a department in an organization.

4. *Administrative Work.* The maximum amount of responsibility the engineer can assume, provided he has superior ability and experience, consists of work at the administrative level. In such a capacity, he is concerned with the broad aspects of the operation of his company, including general policy, organization and coordination, personnel, finance, law, and public relations. Many engineers hold administrative positions, especially in engineering industries.

On his first job the young graduate is usually known as a junior engineer. Later, when he engages in supervisory work, he may bear any one of such titles as engineer, senior engineer, group leader, resident engineer, or supervising engineer. Men on the administrative level are known as managing engineers, chief engineers, and the like.

For any of the levels of work and responsibility described above, a college degree from a reputable institution is almost indispensable. For many levels, especially in research, graduate degrees are increasingly common and necessary.

EMPLOYMENT OF ENGINEERS

Graduates of engineering colleges are employed in many diverse positions and organizations. Because of the broad and fundamental character of the education which they receive in accredited colleges of engineering, plus regular work periods in industry and engineering offices during the summers and other college vacations, they quickly adapt themselves after graduation to their positions. A major fraction of the graduates ultimately attain positions of responsibility and trust in industry, government, and business.

The most attractive positions for graduate engineers who aspire to high professional status in the fullest meaning of the term are, of course, in engineering organizations or consulting firms which render professional and management services to industry, business, and the public in general. Furthermore, large industrial companies maintain complete engineering offices within their own organizations, and offer the graduate fine opportunities for professional growth and advancement. Manufacturing and construction also utilize many graduates with varying degrees of training and experience.

Equally high professional status is enjoyed by the engineer employed in governmental agencies at national, state, and city levels. Outstanding of these, from the technical point of view, are the Bureau of Standards, the Army Corps of Engineers, the Bureau of Reclamation, state highway departments, city engineers' offices, and many government research and development agencies, as well as technical control boards and commissions operating under governmental authority.

More and more qualified engineers are finding employment in sales and service positions in industrial concerns manufacturing highly specialized and complicated products, primarily because of the technical problems involved in the installation and operation of such equipment.

WOMEN IN ENGINEERING

There are excellent opportunities for women in the engineering profession, and many women have become outstanding in their particular fields of interest. Over the past several years there has been a steady increase in the ratio of women to men students enrolled in engineering curricula in colleges and universities. Girls who have done well in such high school subjects as mathematics, chemistry, and physics should seriously consider the possibilities of engineering careers. Even if they do not contemplate engineering as a permanent career, such persons will find the association with engineering students and the undergraduate training of value as a background for community leadership later on.

Additional information, including the booklet "Women in Engineering," is available from the Society of Women Engineers, 29 West 39th Street, New York 18, New York.

THE KIND OF EDUCATION NEEDED BY THE ENGINEER

Because engineering is a mental occupation — though it requires certain manual aptitudes and skills — the education of engineers is aimed mainly at developing mental ability. This goal is not reached overnight; as a matter of fact, the real educational process never ceases. In general, however, engineers gain their formal education on three distinct levels: (1) high school, (2) college or university, and (3) post-university industrial training courses.

At the high school or "pre-engineering" level you should begin to think about whether you want to aim toward the engineering profession. For this reason it is recommended that you perform a preliminary analysis of yourself while you are still in junior high school or high school. To get a good foundation for more advanced work at the college level, in your high school studies you should achieve the following:

1. A complete mastery of the principles of arithmetic, of algebra, plane and solid geometry, and trigonometry.
2. A thorough understanding of physics and chemistry.
3. A good background in English.
4. Some knowledge of government, so that you can understand better the society in which you live.
5. Superior ability to study efficiently.

Unfortunately too many high school students are coming to college deficient in English, mathematics, physics, or chemistry. Large numbers of prospective engineering students are graduating from high school with too great a percentage of their courses in shop work and too little training in basic subjects and in the social sciences. The person who suffers from this deficiency or is an inefficient student will have trouble in meeting the scholastic standards of a university or college.

The second or college level of an engineering education is that with which you will be most directly concerned in the near future. Your graduation from college does not make you a finished engineer, but it will give the foundation on which you can build your career through experience and continued study.

In fact, this foundation resulting from college training is so important to your development as an engineer that you should thoroughly understand and appreciate the objectives of your college work. Fundamentally these are to gain knowledge, to develop the mental skills necessary in

utilizing this knowledge, and to perfect the proper attitudes and personal characteristics which will enable you to become a successful engineer and a good citizen. A clearer picture of these objectives is presented in the following outline.

OBJECTIVES OF THE ENGINEER'S COLLEGE TRAINING

I. To Gain Knowledge
   A. Fundamental laws and principles
   B. Factual engineering information
   C. Cultural, sociological, and economic background
II. To Develop Mental Skills
   A. Facility in expressing yourself both by words and by graphic devices
   B. Facility in visualizing and comprehending
   C. Imagination, ingenuity, and resourcefulness
   D. Ability not only to find sources of information but also to discriminate between pertinent and immaterial information
   E. Ability to think straight, to reason logically from fundamental principles, and to reach correct conclusions
   F. Ability to analyze, evaluate, and synthesize (the "engineering method")
III. To Develop Proper Attitudes and Personal Characteristics
   A. Honesty with facts and men
   B. Realization of citizenship responsibilities
   C. Spirit of cooperation with others in a common endeavor
   D. Leadership
   E. Industry, initiative, and self-reliance
   F. Confidence in your ability to learn and to carry on individual studies, investigations, or research efforts

These objectives are achieved in different ways. The first group and parts A and B of the second are gained largely through your scholastic work. Parts C through F of the second objective and the development of many of the attitudes you need are supplied not so much by the subject matter taught in your courses as by the mental freedom which the method of teaching permits and which your instructors encourage.

The last objective concerns the development of those personal characteristics which are necessary to build both a successful career and an effective personality. Although the first group can be acquired in part through your academic work, development of a good personality calls for informal association with your fellow students and instructors. You will find many opportunities to improve and enjoy yourself socially by

attending parties, church activities, banquets, and dances, and by participating in the student activities described later in this bulletin.

This recommendation is stressed here because in the past engineers have often been justly accused of having little social consciousness. This deficiency is being remedied more rapidly than many people realize; even so, the engineering student often becomes so engrossed in his academic work that he tends to put off participation in social activities until after graduation, when he thinks he will have more time.

The engineer also needs to develop certain physical skills, at least to a moderate degree. These include drafting ability, use of instruments and tools, skill in arranging and setting up equipment, and neatness in preparing reports.

A final word about your college work, before we discuss the post-college phase of your formal education.

In each engineering curriculum, provision is made for several units of elective courses. The object is to permit you to broaden your training along whatever lines you desire. Therefore instead of regarding these elective courses as a necessary evil in your curriculum, as do some engi-

Civil engineering student doing plane-table mapping at summer surveying camp in upper Minnesota. Each civil engineering student spends five weeks at Camp Rabideau between his second and third years of study.

neering students, you should select each elective to fit into a common purpose. A few of these goals are indicated in the following list:

1. To develop your cultural background.
   Subjects which accomplish this purpose include literature and the fine arts, history, astronomy, and languages.
2. To develop your sociological background.
   Subjects that do this include social psychology, sociology, history, economics, political science, and geography.
3. To develop a hobby for recreation.
   Subjects in this group can be selected from anything that you are interested in — astronomy, archaeology, zoology, botany, literature, music, and dramatics.
4. To provide knowledge in subjects related to professional work.
   This group consists largely of courses such as economics, accounting, psychology, industrial relations, engineering law, technical report writing, or speech.
5. To develop a combination of engineering and another career.
   To accomplish this purpose most of your electives should be selected from a single area such as business administration, education, law, journalism, or political science.

The third and final phase of your engineering education will come in industry after you graduate. Many organizations have formal post-college training courses which are conducted under any one of several plans. In one plan the course runs for a period of a year. In another the formal training is sandwiched in with your regular work, and the time is usually extended — sometimes up to five years. Other plans may consist of any combination of these extremes, but most large companies also offer refresher courses which you are encouraged to take periodically.

Even though this last phase of your formal education may cease in a few months or years, your education in the true sense never stops. Real education comes from the inside; you educate yourself. Contrary to the belief of many people, education does not mean "the pouring of knowledge into," but rather " 'the leading out of' a state of mental confusion due to lack of knowledge." In the primary schools and in many secondary ones this "leading out of" is done for you by your teachers. In college, and to a still greater degree in your first industrial experience, you take over. You lead yourself out of mental confusion, with only such assistance from your instructors or supervisors as is needed to help you develop this ability. And throughout the rest of your career, your further education lies in your own hands.

ENGINEERING REGISTRATION

The various states have laws to define and govern the practice of engineering. Also, there are state organizations of professional engineers, and the National Society of Professional Engineers represents the interests of professional engineering on the national scale. You should understand what registration means, what its benefits are, and how it can be obtained.

Legal registration of members of the engineering profession is an exercise of the power of every state for protection of the public health and safety. Such registration gives assurance that only those persons who meet fixed educational, knowledge, and experience requirements may practice engineering. It also tends to insure the ethical practice of the profession.

By law, registration is required only of those who "offer their services to the public as professional engineers." However, many engineers not in this position find it desirable to obtain registration for at least two reasons — they may wish to enter public engineering practice at a future date, and they will benefit from legal competence as private engineers in such matters as expert testimony for court cases. In addition, an increasing number of companies are requiring registration before advancing a man to a responsible position.

As an individual, then, you will gain in two major ways by going through the registration process: first, you will have authority to practice engineering before the public, and second, you will establish your professional standing on the basis of legal requirements.

You can take your first step toward registration just before or soon after graduation from engineering college. You do this by passing a two-part state board examination on the theory and principles of engineering, after which you are certified as an "Engineer-in-Training." After acquiring the experience deemed necessary under the state law (generally four years) the individual holding the Engineer-in-Training certificate need only demonstrate, usually by examination, that he has obtained the requisite experience in order to be certified as a professional engineer.

Details of state laws frequently vary, but the board of registration is essentially interested in knowing that the applicant has acquired the basic knowledge necessary to insure his technical competence with the support of later experience.

In every college of engineering you will find administrative officers and faculty members who can give you further information about the registration requirements of your state, the official name and address of the registration board, and the steps you can take in moving toward registration.

GRADUATE STUDY

Whether to take graduate work, and when, is a decision which requires careful thought. Should you go directly into industry and take advantage of the training courses it offers, or should you stay on and study for the M.S. or Ph.D. degree?

Most men find that a sound decision can hardly be made before the senior year. We suggest that as a sophomore or a junior you investigate the graduate offerings available in your own department and at other universities. A change of schools will help give the broadened viewpoint necessary for successful graduate work. Find out what is needed in the way of background knowledge, ability to use foreign languages, and special technical skills. Learn what graduate assistantships and research fellowships are available at institutions you might wish to enter.

As you get within a few months of graduation, make another inventory. At that time, too, talk with faculty members and with men in industry about the over-all economic picture and about prospects in the industries that interest you — prospects for you if you go to work after getting your B.S. degree, prospects for you if you have a higher degree.

Even more important, analyze your own capabilities for graduate

Students in hydraulic engineering run tests to determine the flow characteristics of a new type of culvert developed for the Illinois Division of Highways. Scale of the model is shown by the roadway and shoulder strips above the culvert in center.

work. The grades you have made in your undergraduate courses are one index, but only one; if you are planning on graduate study, however, your grades must generally be above average. What counts most is whether you have such traits as these:

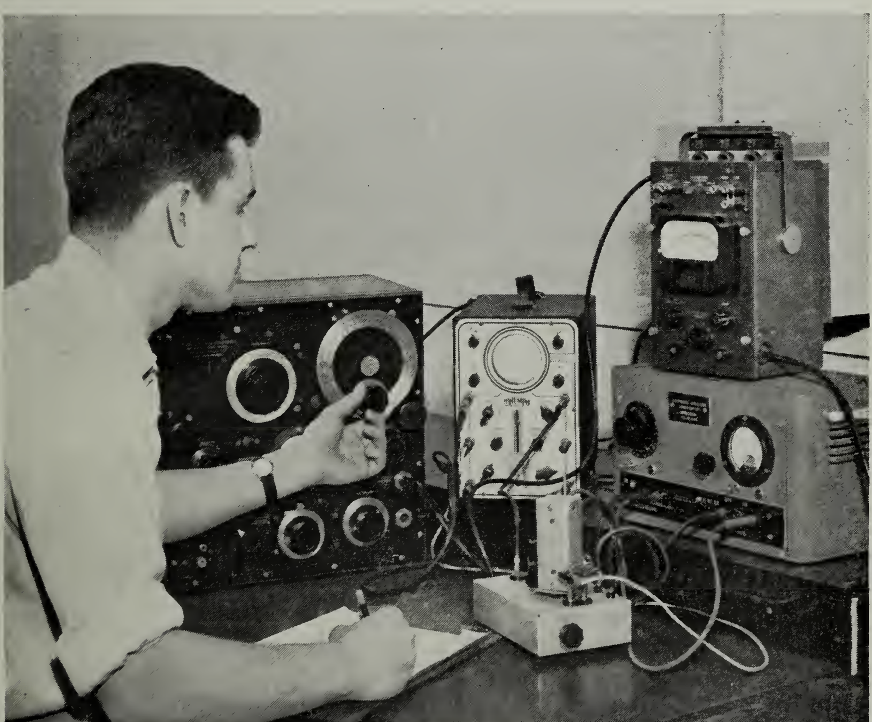
1. Intellectual ability and curiosity.

2. Desire to tackle new problems whose solution may or may not be immediately applicable in practice.

3. Willingness to combine with this desire a considerable persistence and determination.

4. Initiative and originality in planning approaches to a problem and in getting information. Many fields of graduate study demand also more adeptness in the various laboratory skills than many undergraduates possess; some fields demand in addition a broad reading knowledge of one or more foreign languages.

An experiment in the radio engineering laboratory: ample modern equipment is provided.



III. CHOOSING YOUR COLLEGE OF ENGINEERING

Choosing the college to attend is a major step in the educational planning of any high school student. Its importance should not be discounted by false reasoning or by lackadaisical attitudes. In some cases, such a decision must be based on meager information and observation, but in general there is no excuse for an inadequate background of facts upon which to base the selection.

CRITERIA FOR CHOOSING YOUR COLLEGE

There are some two hundred colleges of engineering and institutes of technology in the United States offering accredited curricula, and approximately one-quarter of that number in addition have not been accredited. These figures do not include the so-called technical institutes or schools of the mechanic arts and trades.

The greater proportion of the accredited colleges and institutes of technology are state-supported. Some are located in privately endowed universities, such as Stanford, Northwestern, Lehigh, and others, and some are independently organized and operated, such as the Massachusetts, Illinois, and California Institutes of Technology, and a number of others.

Entrance requirements differ moderately, but tuition costs vary widely among these institutions. So do the buildings, climate, topography, housing, emphasis on sports and extracurricular activities, standards of scholarship, and other well-known attributes of college campuses. All these factors must be appraised and taken into account.

In the final analysis, however, these usual and somewhat obvious features of college life must be weighed and balanced against the more important factors of faculty, emphasis on research, facilities in the way of modern laboratories and equipment, and the curricula which an institution has to offer.

Institutions may also be compared in the light of the reputation and prestige they have attained in the eyes of the general public and in the esteem of the profession. These aspects are less tangible and less evident to the high school student than the more glamorous and obvious aspects of the college picture, but they are much more important and worthy of careful consideration.

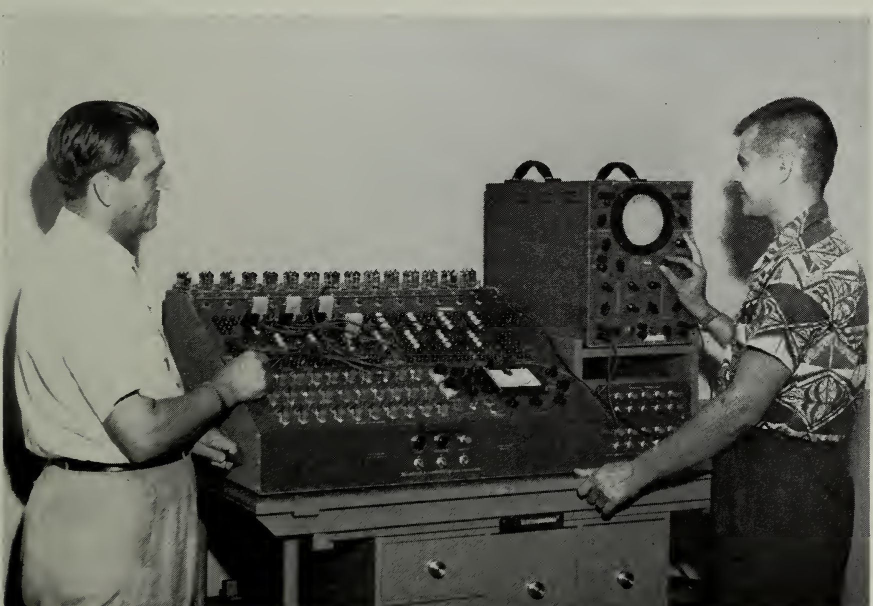
Primarily, a college of engineering must be judged by the strength of the curricula it offers. This depends, of course, both upon competent, interested instructional staffs and upon modern, well-equipped labora-

tories, classrooms, and libraries. Functional and well-designed buildings are also important. Not every school can offer all the curricula that cover the different fields of engineering. To be considered at all, a curriculum should bear the seal of approval of the Engineers' Council for Professional Development, the recognized accrediting agency. The agency's ratings are matters of public record through annual reports.

Comparisons of curricula, staff, and facilities of the various institutions can be made most easily through study of their published catalogs and bulletins. These are or should be on file in the libraries and offices of counselors and administrators of every high school. They can also be obtained without cost by writing directly to the deans of engineering of the institutions in which one is interested.

The prospective engineering student can, if he chooses, postpone the final selection of his engineering college for one or two years after graduation from high school, by attending a college of liberal arts and sciences or a junior college that offers pre-engineering courses and curricula. Many of these programs of study are patterned on the prescribed requirements of standard engineering colleges and orient the student to the type of training that engineering requires.

A small analog computer used in the analysis of machine design problems in mechanical engineering. Several departments have various types and sizes of analog computers, and the University operates a high-speed digital computer laboratory for lengthy problems requiring highly accurate solutions.



ENGINEERING ALUMNI COMMITTEE

To aid high school officials in their regular vocational guidance and career programs, especially where the engineering phases of these programs are concerned, the University of Illinois College of Engineering has formed a state-wide engineering alumni counseling committee. It eventually may serve every high school in the state of Illinois and some cities in border states. The committee began its services to the schools in the fall of 1952, and is gradually extending its operations.

This new service to the high schools is organized by the College of Engineering Advisory Committee, composed of prominent engineers from all sections of the country. As need is expressed, one or more local practicing engineers will make themselves available in each designated school area of the state upon call of the local school officials. Such alumni representatives are supplied with current information about College of Engineering and University offerings and requirements. The service rendered consists mainly of informational discussions with high school students regarding the various aspects of engineering and scientific work and the necessary educational preparations for it. Guidance films, such as "Engineering, A Career for Tomorrow," can also be secured through the alumni representatives.

More complete information regarding this service can be obtained by writing to the Dean of the College of Engineering, 106 Civil Engineering Hall, University of Illinois, Urbana, Illinois.

OTHER SOURCES OF INFORMATION

Supplementing the various counseling agencies of high schools and engineering organizations is the series of books, to be found in any library, on the personal and educational requirements of those who practice the profession of engineering. "Careers in Engineering" is but one of more than a dozen publications available to the inquiring high school student, his parents, and teachers.

The following books and pamphlets are recommended for reading by high school students and counselors in considering engineering as a career.

For Young People

1. Engineering as a Career, by Ralph J. Smith. McGraw-Hill Book Company, Inc., New York, New York, 1956, 358 pages. Excellent description of what an engineer is and does.
2. After High School — What? Engineers' Council for Professional Development, 29 West 39th Street, New York 18, New York, 5 pages, 3 cents each.
3. Need Financial Aid for College? Engineers' Council for Professional Development, 29 West 39th Street, New York 18, New York, 5 pages, 3 cents each.
4. Your Career in Industry as a Scientist or Engineer. Education Department, National Association of Manufacturers. Published and distributed as a public

service by the National Research Bureau, Inc., 415 North Dearborn Street, Chicago 10, Illinois.

5. Engineering — A Creative Profession. Engineers' Council for Professional Development, 29 West 39th Street, New York 18, New York, 1956, 20 pages, 25 cents.

For Parents and Advisers

1. An Engineering Career for Your School-Age Child, by J. S. Lampe. General Motors Corporation, Department of Public Relations, Detroit 2, Michigan, 1956, 15 pages, free. Information about today's shortage of trained engineers and scientists, the advantages of an engineering career, the variety of opportunities available, the bright future ahead in this field, typical requirements for admission to engineering colleges, and financing the college education.
2. Annual Report of Engineers' Council for Professional Development. 29 West 39th Street, New York 18, New York, 70 pages, $1.00. Includes summaries of committee activities, and lists of accredited curricula leading to first degrees in engineering, arranged both by institution and by curriculum. Lists of accredited curricula are reprinted separately, 25 cents.
3. Manual for Engineering Career Advisors. Engineers' Council for Professional Development, 29 West 39th Street, New York 18, New York, 1956, 20 pages, 20 cents.
4. Do I Have Engineering Aptitude? by A. P. Johnson. Engineers' Council for Professional Development, 29 West 39th Street, New York 18, New York. In units of fifty or more only — 50 for $2.

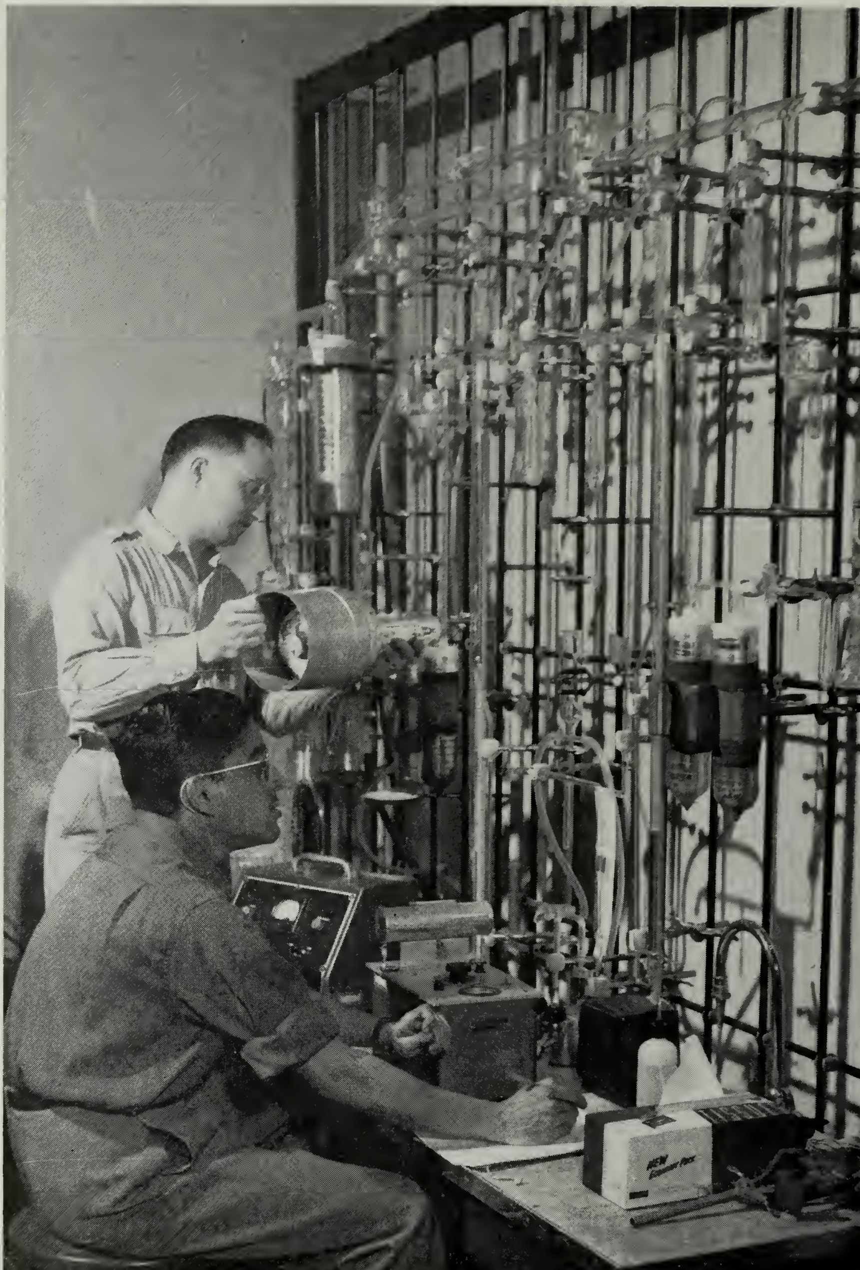
For Women Interested in Engineering

1. Professional Engineering — Employment Opportunities for Women. Bulletin #254, Women's Bureau, U.S. Department of Labor, Superintendent of Documents, Government Printing Office, Washington 25, D.C., 1954, 38 pages, 20 cents. Discusses engineering manpower and prospects for women, traditional attitudes, women's mechanical aptitude, training opportunities, number of female professional engineers, and fields of specialization for women.
2. Women in Engineering, edited by Patricia L. Brown. Society of Women Engineers, Engineering Societies Building, 29 West 39th Street, New York 18, New York, 1958, 40 pages, free.
3. Women in Engineering, by Alice K. Leopold, Assistant to the Secretary of Labor and Director of the Women's Bureau, U.S. Department of Labor. *American Engineer,* August, 1959, pages 31-34.

For Students Interested in Technician Training

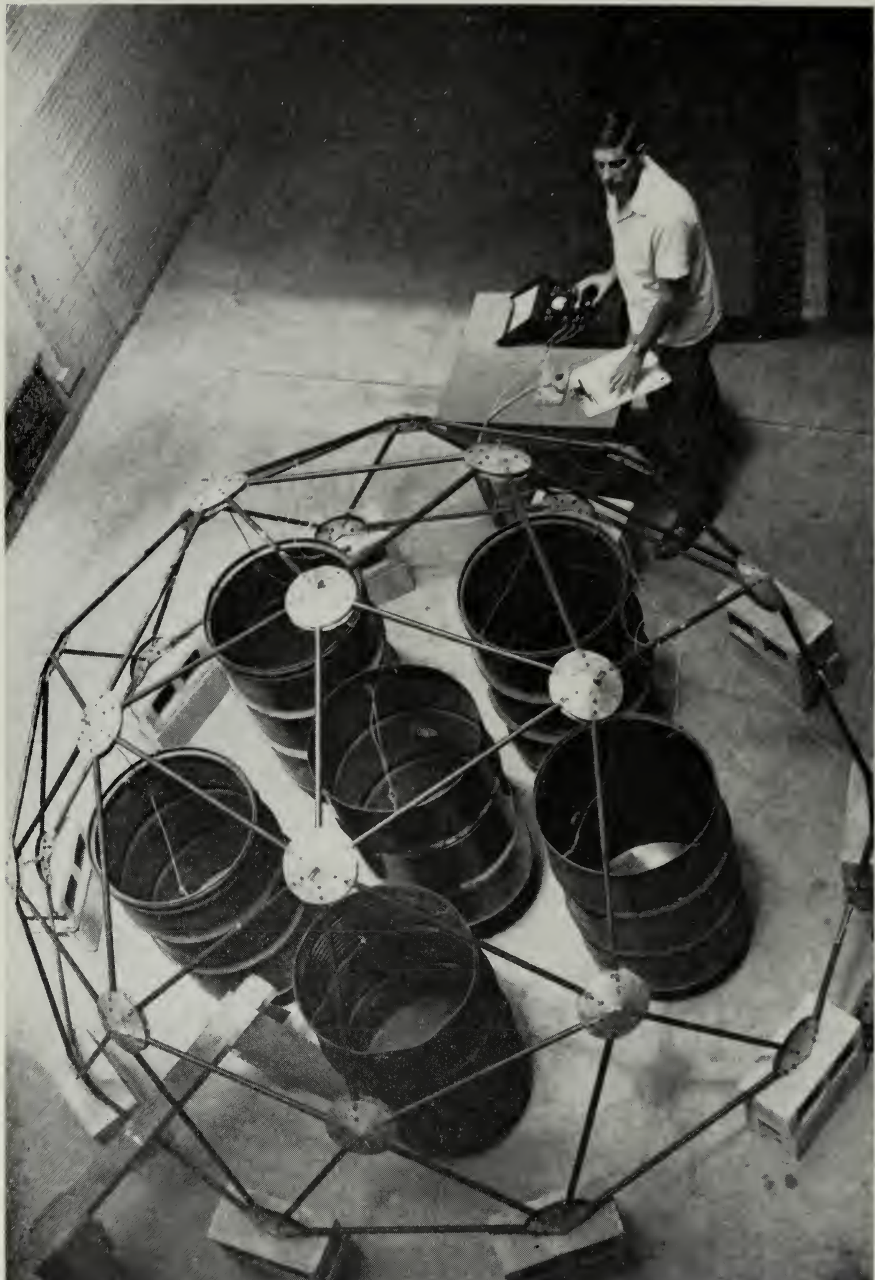
1. Accredited Technical Institute Programs. Engineers' Council for Professional Development, Engineering Societies Building, 29 West 39th Street, New York 18, New York, 6 pages, 25 cents. Contains a list of twenty-three accredited technical institutes.
2. Can I Be a Craftsman? General Motors Corporation, Department of Public Relations, General Motors Technical Center, Detroit 2, Michigan.
3. The Engineering Technician. A joint publication of the Engineers' Council for Professional Development, the National Council of Technical Schools, and the Technical Institute Division of the American Society for Engineering Education. Available from the American Society for Engineering Education, 1201 West California, Urbana, Illinois, 1957, 16 pages, 25 cents.

(University of Illinois guidance publications are listed on the inside back cover of this bulletin.)



Fermentation apparatus in chemical engineering enables biochemistry students to study all types of biological action.

PART II | THE UNIVERSITY OF ILLINOIS COLLEGE OF ENGINEERING



A senior student in agricultural engineering uses strain-gage equipment to determine stresses in a new low-cost type of structural frame.

IV. OBJECTIVES

The College of Engineering stresses these aims — aiding students to think clearly and accurately, giving them the fundamentals of sound engineering, and affording them opportunities to put into effect the doctrine that one of the engineer's main functions is to contribute to effective practical action. All this implies treating the student as an individual and encouraging his initiative and self-reliance.

The College, then, emphasizes a thorough grasp of the engineering method and of basic laws and principles, rather than mere familiarity with processes that may change in time and vary from place to place. The College also urges every student to begin gaining a comprehensive view of the economic and social world in which he lives, and an understanding of his place in it, as well as a firm grasp of scientific and technological fundamentals. It encourages him to take full advantage of the resources of the large university to which the College belongs. Finally, administrators and teachers proceed on the belief that the engineer's knowledge, skills, and judgments are of little avail until they are communicated to others and serve as the basis for action.

These basic policies yield several corollaries: small classes and individual contact with instructors; an effective system of faculty advisers; student participation in research; no sharp separation between a staff member's teaching and research but, instead, stress on the desirability of his engaging in both activities; and a continuous appraisal, by the departments and by the College, of the methods of teaching and counseling which they use.

In addition, the College considers that its obligations include helping students to find positions in industry and government which will utilize their specific abilities to the best interest of the student himself, of his employer, and of society as a whole.

V. DEPARTMENTAL FACILITIES AND POLICIES

AERONAUTICAL AND ASTRONAUTICAL ENGINEERING

The formal instruction in aeronautical engineering is intended to prepare the student basically for any one of the four subdivisions of the field, aerodynamics, structures, propulsion, or design. For that purpose, the curriculum emphasizes mathematics as a basic tool, and includes classroom discussion and laboratory participation in aerodynamics, structures, and propulsion as well as classroom time devoted to design. In addition, superior undergraduate students are encouraged to carry out special projects or research, usually in their own area of special interest and in collaboration with one or more graduate students.

For instruction in aerodynamics, facilities include a horizontal, return-flow wind tunnel with a 30 by 48 inch test section and a maximum air speed of 130 miles per hour, a continuous-flow transonic wind tunnel, a supersonic "blow-down" wind tunnel, a smoke tunnel for visual observation of air flow, and a modern shock tube. In the field of propulsion, there is equipment for the study of gas turbine, pulse jet, and ram jet combustion chambers, gas turbine nozzles, turbine wheels, and turbine and compressor blading, as well as for research devoted to present and future reaction engines. In structures, testing machines are available for both static and dynamic testing of aircraft materials and airframe components.

In addition, under the direction of the Institute of Aviation, the University operates a 763-acre modern airport with three concrete runways, each 5300 feet long. The Institute operates a fleet of over thirty aircraft and offers courses in pilot training and aircraft maintenance leading to Civil Aeronautics Administration licenses. Within certain limits, these courses are acceptable in the aeronautical engineering curriculum. As an extracurricular resource, a very active University Glider Club operates from this airport for those students interested in this hobby. The Club has access to facilities for repairing and constructing its gliders in the airport shops.

AGRICULTURAL ENGINEERING

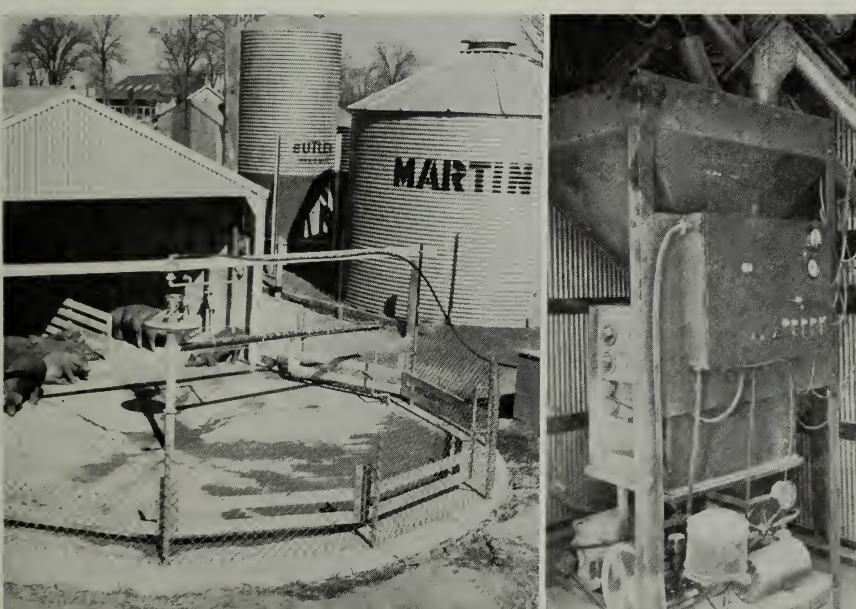
The Department of Agricultural Engineering is housed in two buildings located near the south end of the Illinois campus, and includes offices, classrooms, teaching laboratories, and research laboratories. In addition, a part of the Agriculture Experimental Farm is assigned specifically to

the department for teaching and research, and the entire facilities of the Experimental Farm — buildings, land, and livestock — are available for teaching and cooperative research.

The curriculum in agricultural engineering contains the same basic courses as do all other engineering curricula but adds some fundamental courses in agriculture. In the senior year the student has an opportunity to specialize by choosing technical electives in one of the four following areas: farm electrification and processing, farm structures, farm power and machinery, or soil and water control. During the senior year, too, each student selects and works on a special problem. This provides an opportunity to follow special interests and to report his results and conclusions. He also obtains valuable experience in attacking and formulating solutions for problems comparable to ones he may face soon after graduation.

Many of the students in agricultural engineering have further opportunity to work part-time for the department. This enables the student to become familiar with and actually participate in some of the research work of the department, and to become personally acquainted with individual staff members.

An experimental swine housing system designed to feed the hogs and clean the feeding floor automatically. Mechanizing farm operations offers a major challenge to agricultural engineers.

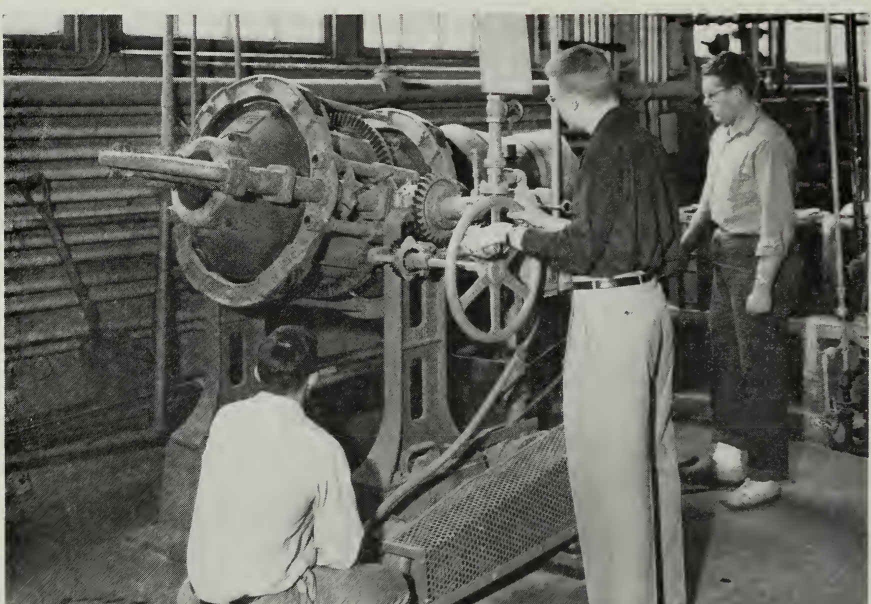


CERAMIC ENGINEERING

The Department of Ceramic Engineering is concerned with much more than the traditional fields of glass, whiteware, porcelain enamels, refractories, and structural clay products. It conducts an active program of research in high-temperature and special-characteristic materials of use in ultra-modern devices, including electrical ceramics for capacitors and thermistors, adhesives, metal-ceramic combinations or cermets for such applications as gas-turbine blades and missile re-entry shapes, heat-resistant electrical insulating coatings, refractory oxides for pressure-casting of steel, metal-protective coatings, and high-capacity ceramic-metal brake linings.

Ceramic engineering offers an excellent field for graduate study, and has wide opportunities for interesting careers at both the bachelor and advanced-degree levels. The number of ceramic engineers has always been insufficient to meet the demand; with the rapid expansion of ceramics, future needs for engineers will be still further ahead of expected numbers. Promising employment opportunities are therefore available to students in the department, who are increasingly entering the research and development phases of the industry as well as production.

Semi-plant-size standard commercial units in ceramic engineering, such as the rotary smelter shown here for the batch melting of enamels or glass, enable students to familiarize themselves with industrial means of translating scientific principles into practice.



With its own large, well-equipped building, including eight major laboratory groups, its own library of 3500 volumes, and a museum illustrating both the industrial and artistic phases of ceramic manufacture, as well as an active faculty and research program, the department is well equipped to help fill the demand for graduates.

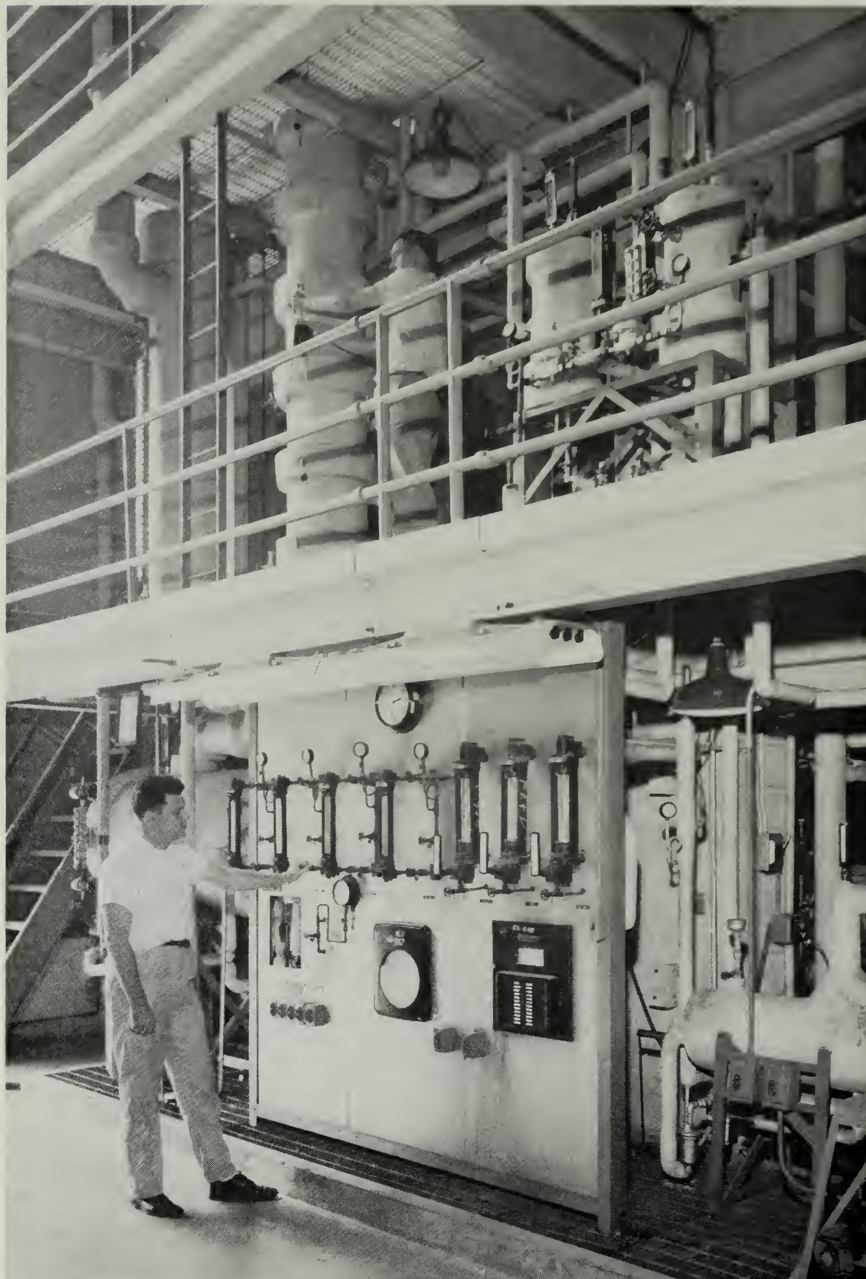
Facilities for undergraduate demonstrations and experiments include all the apparatus and machinery required for the processing and analysis of materials to make all types of refractories, structural clay products, pottery, glasses, glazes, and enamels for study and testing. Students are first given experience in laboratory experiments on a bench scale, and then with semi-plant-size machinery; this offers them an opportunity to operate commercial equipment. Thus graduates are familiar with both laboratory and production problems, and are equally prepared for industry or research work.

In carrying out the important research functions of the department, excellent special-purpose laboratories and equipment are supplied. These include furnaces with highly accurate automatic temperature and atmospheric control, and analytical methods such as X-ray.

For instructional work with glass, specially-constructed high-temperature furnaces are used for the melting of experimental compositions, with test equipment to determine the resulting physical properties. In the whitewares laboratory and the associated mold shop, raw materials can be processed into dinnerware, electrical porcelain, artware, and pottery.

The kiln laboratory, 100 by 42 feet, has eight industrial units ranging from five to 50 cubic feet capacity, with temperatures up to 3000° F., two rotary and eight pot-type smelters for the preparation of glazes, six electric furnaces up to 14 feet in capacity, and unusually complete equipment to record temperatures and control firing. For structural clay products there are a brick-making unit and auger machines for small shapes, crushing and mixing machinery, a 400,000-pound hydraulic press, and a dryer with forced-air circulation and automatic temperature-humidity control.

The enamel laboratory is completely equipped for the chemical cleaning and pickling of sheet iron and the sandblasting of cast iron, with furnaces for smelting enamels, and auxiliaries for dipping or spraying. The enamels are fired in six automatically controlled furnaces, the largest 24 by 24 by 40 inches. Testing is done with commercial research and control apparatus. The microscope group includes instruments with which particles of all sizes in the range of optical visibility can be studied and photographed.



A view in the unit operations laboratory of chemical engineering, showing centralized instruments and controls for the six-plate distillation column above.

CHEMICAL ENGINEERING

The Chemical Engineering Division of the Department of Chemistry and Chemical Engineering is located in the East Chemistry Building, completed in 1950. An area of approximately 65,000 square feet is devoted to instruction and research in chemical engineering, and includes four major laboratories.

The unit operations laboratory occupies three full floors of the building, with an open bay area passing from the bottom to the top floor for distillation towers and other tall equipment. Experimental units, such as filters, heat exchangers, driers, absorption towers, and apparatus for the study of the flow of fluids are installed here. This equipment is used for experimental studies by seniors in chemical engineering.

Facilities for undergraduate training in research and in the study of chemical engineering processes are located in the projects laboratory. Here students carry out individual problems similar to those encountered in industry, and ample space is allotted for equipment to be designed and built by students.

The measurements and instrumentation laboratory contains apparatus for studying the methods used in measuring, controlling, and recording pressures, temperatures, rates of flow, liquid levels, and other physical quantities. Equipment for studying the physical properties of materials at pressures up to 250,000 atmospheres is located in the specially-designed high pressure laboratory.

Additional facilities available in the East Chemistry Building include an electrochemistry laboratory, a refrigeration room, a microscopy room, constant-temperature and constant-humidity rooms, two machine shops, a crushing and grinding laboratory, lecture rooms, and research areas.

The chemical engineering staff members conduct research on both the undergraduate and graduate level. Fields of research interest include heat transfer, fluid dynamics, kinetics, high pressure, electrochemistry, and mass transfer. Undergraduate options, to be chosen at the start of the junior year, include (1) standard option for students who plan to enter industry after receiving the bachelor's degree, (2) science option for students who intend to go on for advanced study, and (3) bioengineering option for students who plan to enter fermentation or biochemical industries.

CIVIL ENGINEERING

The Department of Civil Engineering offers a program leading to the Bachelor of Science degree in civil engineering. Students receive a systematic training in the basic principles underlying planning, design, and construction in the four major subdivisions of civil engineering, namely:

structural engineering, transportation engineering, hydraulic engineering, and sanitary engineering.

During the first year the courses are the same as those required of all College of Engineering first-year students. During the second and third years, the courses are the same for all students working for degrees in civil engineering.

For the fourth year, however, the student takes certain courses required of every one and then has an opportunity to select in addition courses in the field of his major interest. The fields of major interest recognized are: (1) structural design and construction; (2) highway planning, design, and construction; (3) railway design, construction, and maintenance; (4) hydraulic design and construction; (5) sanitary engineering; (6) surveying and mapping; and (7) construction planning, methods, and equipment.

The last two fields of major interest cut across the others. In the area of surveying and mapping the student follows the development of the science and the art of surveying and mapping; the compiling of maps for both surface and subsurface features of the earth, including the prepa-

Junior students in the concrete laboratory determine the air content of a sample of freshly made concrete using a pressure device based on Boyle's law. A small amount of entrained air in the concrete improves the resistance of the concrete to the deleterious action of ice-removal salts.

ration and use of aerial photographs; the description of lands for transfer of title; and the making of location and alignment surveys for all types of engineering construction.

For the student interested in a career in construction, the construction planning, methods, and equipment elective courses offer an opportunity to concentrate in that field. Here the student reviews the planning and controls practiced in the building of engineering works to secure the most economical and efficient use of men, machines, and materials.

Specialization in any one of the subdivisions of civil engineering provides the basic training for any of the other subdivisions, because in each program are included the courses embodying the fundamentals upon which engineering decisions are based. Training in civil engineering is also a valuable background for a career in science or in other fields of engineering.

The office of the department is located in Civil Engineering Hall, together with classrooms, design rooms, and faculty offices. Additional classrooms, laboratories, and offices are located in the following buildings: Talbot Laboratory, Surveying Building, Sanitary Engineering Laboratory, and Hydraulic Engineering Laboratory. Camp Rabideau, a summer surveying camp, is located in the Chippewa National Forest in northwestern Minnesota, near the headwaters of the Mississippi River. Civil engineering students attend the camp for one of two separate five-week sessions during the summer following the second year of study.

ELECTRICAL ENGINEERING

The Electrical Engineering Department is housed in three buildings, the Electrical Engineering Building, the Electrical Engineering Research Laboratory, and the Electrical Engineering Annex.

The Electrical Engineering Building is well equipped and has classrooms and laboratories for use in teaching undergraduate and graduate students. There is a corresponding laboratory course to be taken simultaneously with almost all theory courses.

The laboratory courses in communications and electronics include all of the new devices such as transistors, pulse circuits, and micro-waves, as well as the more familiar ones such as transmission lines, radios, and antennas. There are five laboratories with full complements of modern equipment and measuring instruments. The working areas are spacious and well lighted.

Electric power employs three laboratories. The machinery laboratory contains a wide variety of motors, generators, transformers, and other specialized electrical machines. In addition to possessing a very high level of illumination for safety, this laboratory is also soundproofed to

provide comfortable surroundings for the student groups using it. The power transmission laboratory has specialized equipment for the study of power transmission, power system metering, and power system relaying. The industrial electronics laboratory is equipped with the most modern tools and devices for demonstrating the applications of electronics to industrial needs.

A large part of the work in illumination engineering is conducted in a unique illumination demonstration laboratory. The general lighting in this laboratory is obtained from many types of fixtures which illustrate modern designs in fluorescent, mercury-vapor, and incandescent equipment. Around the perimeter of the room are other fixtures used in commercial and industrial lighting.

The Electrical Engineering Research Laboratory is used entirely for research purposes. The areas covered include such devices and phenomena as electron tubes, gaseous conduction, antennas and fields, high-frequency instrumentation, semi-conductors, ultrasonics, electrical machinery, and power transmission and distribution.

The faculty of the Electrical Engineering Department has constructed an ultra-modern, 10,000-cycle network analyzer, by means of which

Student group in electrical engineering conducting an experiment in microwave transmission; small working squads are the rule.

complete power systems can be set up in miniature and studied under various operating conditions. The department also has a new analog computer for solving differential equations and other related problems. Also, the excellent digital computer laboratory, operated under the jurisdiction of the Graduate College, has equipment designed and built with the cooperation of the electrical engineering faculty, and is available to all groups who have suitable problems. Courses are also offered in the design and use of both analog and digital computers.

ENGINEERING MECHANICS

The Department of Theoretical and Applied Mechanics offers a four-year undergraduate program leading to the degree of Bachelor of Science in engineering mechanics. The curriculum is designed primarily for those interested in research and development careers in the field of engineering. Throughout the program, special emphasis is placed on mathematics and on fundamental principles. The courses are oriented to help the student obtain a great depth of understanding in the basic sciences (mathematics, physics, chemistry) and in the engineering sciences (mechanics of solids, fluid flow, thermodynamics, etc.) as well as to gain some insight and skill in the application of these sciences to engineering problems.

Included in the study of the engineering sciences is a strong major in theoretical and applied mechanics, consisting of a sequence of courses in mechanics of materials, fluid mechanics, and dynamics. An advanced mathematical background is supplied by the three courses in mathematics required beyond the second-year calculus. At least one course in advanced physics is required. Every effort is made to anticipate as accurately as possible the needs for fundamental knowledge that science and industry will have for some years in the future and to prepare the student accordingly.

Unspecified technical electives are included in the program so that the student can pursue special interests. Provisions are made for technical elective sequences in other departments of the College, including Mechanical, Civil, Electrical, Metallurgical, and Aeronautical Engineering.

Because the engineer is frequently a part of a team consisting of people without scientific training, the program also emphasizes other areas of knowledge which will enable him to understand and appreciate different points of view. Furthermore, the solution of engineering problems sometimes involves the evaluation of certain social and economic values that are more or less intangible and therefore are not easily considered by scientific methods. The humanistic and social studies in the program are intended to round out the engineer's education in these areas.

Opportunities for professional development for engineers with this type

THROUGH DRAWINGS, IDEAS BECOME REALITIES

of background are almost unlimited. Broad training enables the graduate to use a scientific approach to the solution of a variety of problems in any industry or research organization, and often leads also to supervisory and administrative positions.

The Arthur Newell Talbot Laboratory houses the classrooms and most of the laboratories and offices of the Department of Theoretical and Applied Mechanics. In the twelve laboratories of this building, unusual facilities, including closed circuit television, are available for teaching both undergraduate and graduate students and for experimental work and research in all phases of the engineering mechanics curriculum.

GENERAL ENGINEERING

Students who register in the general engineering curriculum take the same basic work in mathematics, science, and mechanics as do all other engineers; the application of these sciences to engineering is insured by following the course sequences either of structural design in civil engineering or of machine design in mechanical engineering. One of the important objectives of these programs is to help develop the engineering method of thought, based on analysis and synthesis.

As is well known, many graduates of engineering ultimately find their way into managerial positions. Although these men have in the past often achieved advancement with little or no formal training in business management, basic principles are always helpful. For the engineer who wishes to guide his own or some other enterprise, or to handle men and affairs, courses in economics, accounting, marketing, management, English and writing, and psychology or personnel relations provide a valuable background for future development.

Within the general engineering curriculum, special programs have been established for the following fields: (1) engineering administration, (2) engineering sales, (3) engineering geology, and (4) publication engineering. Various other combinations can be arranged, provided that they show sufficient unity and substance to be used as the foundation of a well-defined program which meets the approval of the staff. In the past such combinations as engineering-law and engineering-education have been arranged. By a careful choice of electives, it is possible to obtain a degree in law in two and a half years after graduation in general engineering. General engineering also prepares the student for graduate study in civil engineering, mechanical engineering, or theoretical and applied mechanics.

Offices and facilities of the Department of General Engineering are located in the Transportation Building. Every effort is made to encourage faculty and student contact, and each student is assigned a faculty

General engineering includes expression in drawing and writing, as well as administration and sales.

adviser to provide personal attention in planning a program. The adviser is available for consultation throughout the student's academic career.

MECHANICAL AND INDUSTRIAL ENGINEERING

The physical and laboratory facilities of the Department of Mechanical and Industrial Engineering, used by students in both of these programs, are extensive and varied. Laboratories serve a twofold purpose, providing equipment with which research can be conducted at both graduate and undergraduate levels, and also offering means for demonstrating the application of basic principles.

The power phase of mechanical engineering is served by the power laboratory, which contains equipment and facilities for performance tests and verification of the several thermodynamic principles and processes discussed in the classroom. Typical of the equipment are refrigeration units, air compressors, pumps, fans and other heating, ventilating, and air conditioning units, plus all the auxiliaries and instruments necessary for experiments or tests. One unique piece of equipment is the General Electric educational unit. This includes an oil-fired boiler which generates steam at 1500 pounds per square inch and 900° F. to power two turbines connected with 220-volt generators. The whole assembly simulates the operation of a central station electric power plant.

In addition, the internal combustion laboratory in the Mechanical Engineering Building is one of the most modern in the country. It contains gasoline and diesel engines connected to dynamometers for performance testing. In addition, there are special single-cylinder engines, gas turbines, and facilities for the study of heat transfer problems. There is also a full-scale engine-testing room in which an air-cooled aircraft engine is connected to a dynamometer. The unit permits changing intake and exhaust pressures to simulate altitude conditions from 1000 feet below to 20,000 feet above sea level; the temperature can be varied from −40° F. to 150° F.

As with other areas of the department, the laboratory facilities for the industrial-production phase are used to demonstrate and clarify the theory through a physical model. Included are such facilities as a metal casting and sand control laboratory where the principles of metal casting and the various controls are studied and demonstrated.

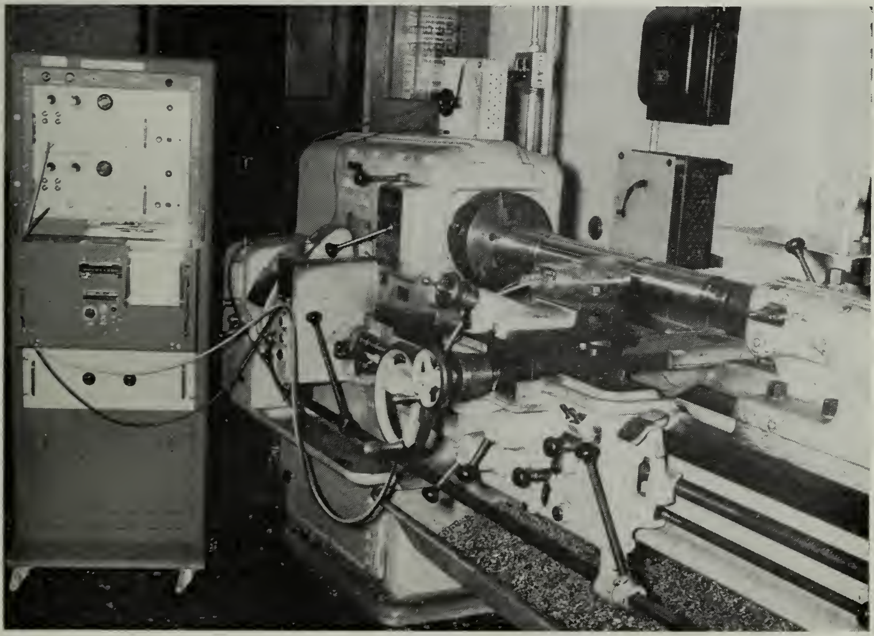
A metal processing laboratory contains a limited number of basic machine tools equipped with dynamometers and instrumentation to study the physical science of metal cutting and forming. Adjacent to this laboratory are research facilities, including strain gage amplifiers and recorders and oscilloscopes to study transient phenomena in metal cutting.

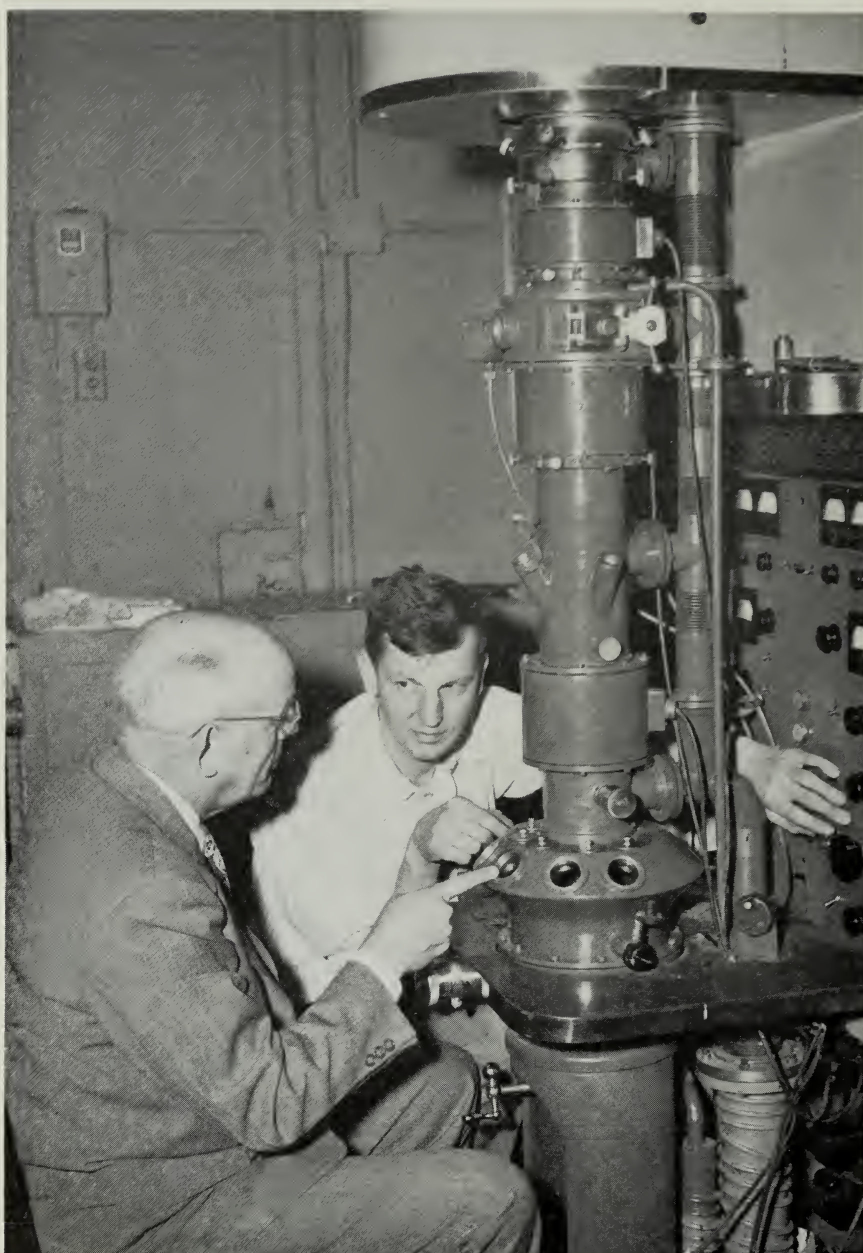
The effect of heat treatment upon the internal structure and properties of metals is demonstrated through experiments in the heat treatment laboratory. Such facilities as small furnaces, microscopes, and testing machines, together with accessory equipment, provide the student with the opportunity to understand the theory and proper applications of metallic materials.

Certain phases of industrial planning are performed in the tool design laboratory. The student plans the process, including the handling of materials, and the arrangement of equipment and tools for the manufacture of a specific product. A selected group of jigs, fixtures, dies, and other production tools, together with a model of an industrial plant are provided.

The motion and time study laboratory provides facilities for methods-time analysis and studies in the principles of work simplification. Case problems typical of factory operations are studied through the use of such equipment as movie cameras, projectors, and models to demonstrate efficient work-space layout.

Metal-cutting research installation in mechanical engineering, utilizing recording strain gages which give information useful in the reduction of tool wear. Simplified equipment of this type is used in undergraduate experiments, and a research philosophy is applied to instruction in machine tool laboratories.





One of several electron microscopes in the University's central laboratory, which is open to and used by departments such as metallurgical engineering, electrical engineering, ceramic engineering, and physics.

The design phase of mechanical and industrial engineering involves the use of classrooms and laboratories where the student acquires a clear understanding and working knowledge of engineering mechanics, static forces, masses moving with constrained motion, and velocity and acceleration, which must be studied in relation to each other as applied to machine elements.

A machine design laboratory enables the student to learn by demonstration the importance of machine design and the effects of properties of materials, types of loading, and existing stress distribution on the design of machine parts. The equipment consists of photoelastic apparatus, vibration table, and demonstration equipment to aid the student in visualizing the various phenomena encountered in machine parts under simulated operating conditions. An analog computer used by advanced undergraduates in classroom and laboratory provides an excellent opportunity to acquire experience in the programming of such devices.

A model room contains actual machine parts, assembled mechanisms, and working models that are discussed and designed in the classroom. These exhibits enable the student to understand and appreciate the derived equations, design procedures, and experience factors used in machine design work.

Certain phases of mechanical engineering, although closely associated with the heat treatment of metals, metal processing, internal combustion engines, and steam power equipment, are of such importance that studies should be made upon them individually rather than as a part of a large complex of equipment. Special laboratories in the fields of instruments and controls, fuels and lubricants, heat transfer, and thermodynamics are provided for this purpose.

MINING, METALLURGY, AND PETROLEUM ENGINEERING

Mining Engineering graduates usually enter the production and subsequently the management phase of the industry. The best preparation for such a career is a broad engineering education rather than a highly specialized one. Hence the undergraduate curriculum in mining engineering includes courses in many topics such as geology, economics, chemistry, civil engineering, surveying, structural engineering, electrical power and machinery, and mechanical engineering, plus mining courses which range from geophysical prospecting through haulage and hoisting to mineral dressing or processing.

The department maintains extensive equipment for laboratory courses in ventilation, coal preparation, fuels, mineral dressing, drilling and blasting, rock mechanics, and other related topics. A large proportion of the undergraduates also work on a part-time basis for the department

assisting with research projects conducted by the faculty. Thereby additional opportunities are provided to learn about current studies in the field of mining engineering.

Metallurgical engineers often find employment in the treatment of refined metals and alloys; topics in this field are therefore emphasized in the undergraduate curriculum. Students may elect either an industrial or research program of study. The latter option is primarily for those who intend to take graduate work and who plan on careers in research or teaching. The industrial option is designed for students planning to pursue some type of manufacturing career after receiving the bachelor's degree, although these students are qualified for graduate study as well.

A very important part of the laboratory instruction in metallurgy takes place in the metallography laboratory, which is well equipped with microscopes, metallographic cameras, dark-room facilities, and other equipment for specimen preparation. Here, the student learns to interpret and correlate the effect of variables in processing and composition on the internal structure and properties of metals. The department also maintains extensive equipment for mechanical working, melting and casting, heat treatment, X-ray diffraction, production of powder-metallurgy parts, mechanical testing, and other related activities.

Many research projects being carried out by the staff give students the opportunity to learn of current studies and techniques in metallurgy. In many cases, students contribute to these programs as part-time assistants.

Petroleum Engineering deals with the problems of reducing to possession the non-solid hydrocarbon deposits found in the earth's crust. There are mechanical engineering problems of drilling holes to tap the subsurface reservoirs, and of designing and installing equipment to lift the liquid and gaseous hydrocarbons to the surface where they are separated and transported (usually by pipelines) to refineries. While further processing and refining are essentially chemical engineering problems, and while the occurrence of petroleum and its location are questions approached by geologic and geophysical methods, these aspects are also studied by the petroleum engineer.

In still another respect, the practice of petroleum engineering depends largely upon an understanding of the flow of fluids through porous media (e.g., sandstones and limestones). Hence the student needs a sound foundation in applied physics and mathematics as well as in theoretical and applied mechanics. Finally, a background in physical chemistry, thermodynamics, and organic chemistry is a desirable supplement to the usual college program.

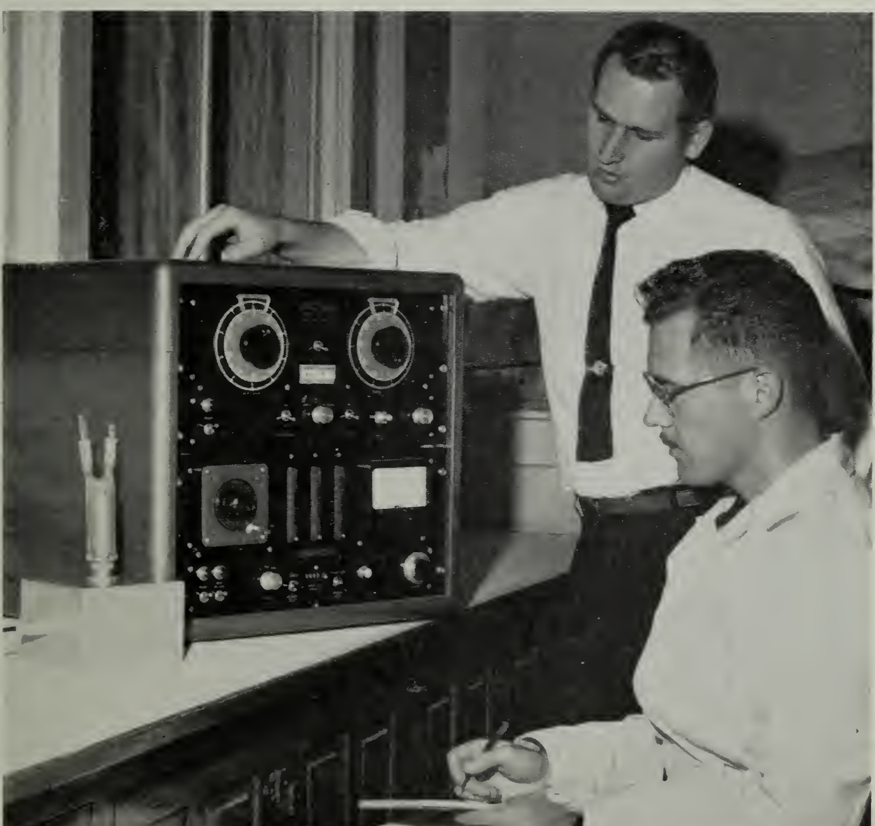
The undergraduate and graduate programs at Illinois in petroleum

engineering emphasize the principles rather than the practice of hydrocarbon recovery methods. Laboratory and analytic approaches to problem-solving are developed, for practical experience can best be obtained through summer jobs and during the extensive training programs offered by industry to all new employees. The practice of substituting numbers in memorized formulae is avoided, although the students are taught that an educated guess is better than no answer at all, especially when phrased with reference to economic considerations.

NUCLEAR ENGINEERING

Nuclear engineering is a new discipline, one which is based on the knowledge and technique developed by many established fields. At the University of Illinois, therefore, nuclear engineering is a graduate pro-

Nuclear engineering requires a thorough knowledge of nuclear radiations and their characteristics. The equipment shown here is being used to measure the energy of beta particles.



gram, administered by an interdepartmental committee representing chemical, mechanical, civil, electrical, metallurgical, aeronautical, and ceramic engineering, theoretical and applied mechanics, physics, and chemistry. The curriculum leading to the master's and doctor's degrees in nuclear engineering is open to every graduate in one of the above disciplines who has the specified high academic standing.

Certain undergraduate courses are also required as background for the nuclear engineering program. These include differential equations, advanced calculus, atomic physics, and nuclear physics. Most engineering curricula and those in physics and chemistry include at least one of the needed mathematics courses. Enough choice of electives is generally available so that the remaining courses can easily be fitted into the undergraduate program of an interested student.

With this preparation, a candidate can obtain a Master of Science degree in nuclear engineering in one calendar year of graduate study. For the M.S. degree in nuclear engineering, a student must complete eight units in graduate courses, of which four must be in nuclear engineering. The Ph.D. candidate must complete 24 units; six units of nuclear engineering are required out of the 24.

Laboratories for graduate teaching and research in nuclear engineering at the University of Illinois have received support through several grants from the U.S. Atomic Energy Commission. Facilities include a boiling-water heat transfer loop, which was put into operation during 1959. A second loop for the study of liquid-metal heat transfer has been designed for future construction.

Central feature of the University of Illinois facilities in nuclear engineering is the TRIGA Mark II, an above-ground tank-type reactor located in its own building immediately adjoining the engineering campus. At an initial rating of 100 kilowatts steady-state power, the TRIGA also has tremendous and intriguing potentialities for repeated short-term "bursts" or flashes of power as high as two million kilowatts. Plans are proceeding to increase the steady-state power level and to pulse the reactor for short intervals.

PHYSICS

The Physics Laboratory houses classrooms, undergraduate laboratories, a large lecture and demonstration hall, the Physics Library, and offices of the Department of Physics. Some graduate and research installations are also located here, as are a machine shop for professional machinists and another for students and faculty.

In three large general physics laboratories for instruction in elementary courses, all engineering students learn the basic principles of physical

measurement and experimentation. Conducting approximately thirty experiments in a year, the student is challenged by the quality of the instruments and equipment to achieve high standards of measurement.

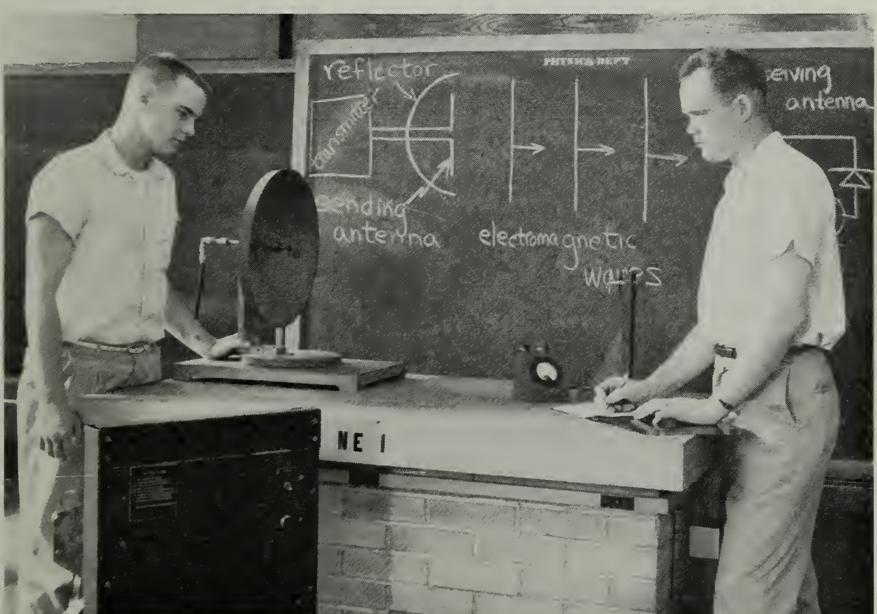
Of the three advanced undergraduate and graduate laboratories available, one is well equipped for electrical and magnetic measurements, another for work in light and spectroscopy, and the last for a variety of experiments in modern research methods and techniques. Because the apparatus in these laboratories is of research quality, the student is encouraged to approach his experiments as research problems.

Complete facilities for cryogenic and solid state research are also available. Liquid helium is employed in attaining low temperatures, and X-ray, nuclear resonance, and other specialized techniques are used in analyzing the structure of molecules and the basic structure of solids.

Housed in a separate building nearby, the cyclotron is capable of accelerating deuterons to an energy of ten million electron volts. The machine is applied in investigating the interaction of heavy particles with each other and with atomic nuclei.

Located on the south campus near the power plant, the Physics Research Laboratory houses 20-million-volt and 360-million-volt betatrons,

In the electrical measurements laboratory of the Physics Department, students are conducting an experiment with the generation, reception, and properties of electromagnetic waves in the radar range of frequencies.



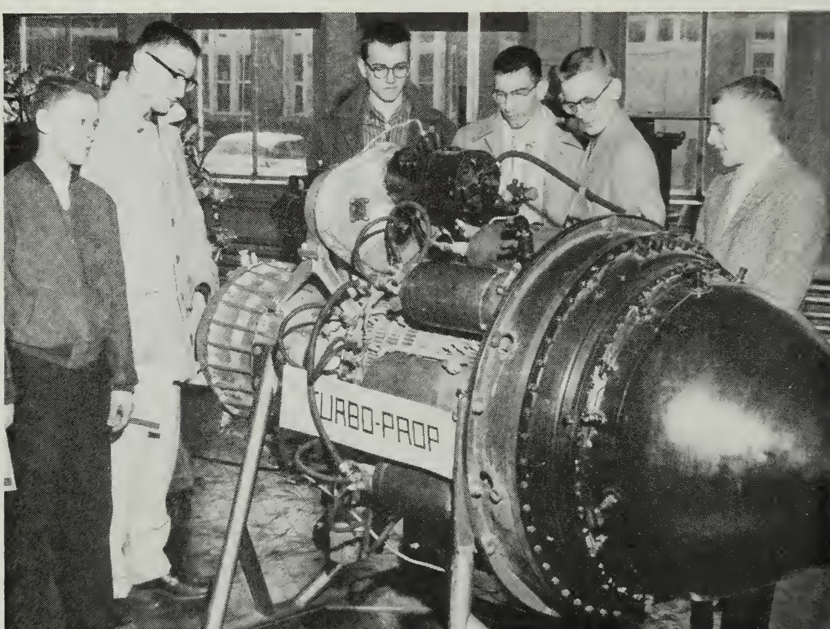
used for research in high-energy particle physics. In addition to the betatrons and associated test apparatus for investigations into the effects of accelerated electrons on atomic and subatomic particles, the building also contains a large machine shop, a glass-working shop, an electronics shop, and facilities necessary for the maintenance and construction of needed equipment.

COMBINED ENGINEERING-LIBERAL ARTS AND SCIENCES PROGRAM

The University of Illinois has recently established a combined, five-year program in engineering and liberal arts and sciences. Upon completion of this program, the degree of Bachelor of Arts or Bachelor of Science in Liberal Arts and Sciences will be awarded simultaneously with the degree of Bachelor of Science in an engineering curriculum. A student must meet entrance requirements in both colleges in order to qualify for this program.

The combined program is most adaptable to the following curricula in engineering and majors in liberal arts and sciences: in engineering, aeronautical, agricultural, ceramic, civil, electrical, engineering mechanics, industrial, mechanical, metallurgical, mining (including petroleum),

High school visitors view an aircraft engine exhibit at the Engineering Open House presented by students of the various departments in mid-March of each year. Some 15,000 guests take advantage of this opportunity to see the subjects and methods of engineering study.



and sanitary; in liberal arts and sciences, anthropology, classics, English, French, German, history, Italian, Latin, mathematics, philosophy, political science, psychology, Russian, sociology, Spanish, and speech.

For further information see the current University bulletin on *Undergraduate Study.*

HONORS PROGRAM AND DEAN'S LIST

To recognize and encourage excellence in scholarship by outstanding undergraduate students, the College of Engineering at the University of Illinois has established a comprehensive Honors Program. This plan provides a maximum of curricular flexibility, additional opportunities for advancement, individual selection of courses, plus experienced and careful guidance through personal contacts with selected faculty members. The Honors Program is open both to entering and advanced students who meet the requirements. At the end of each semester, to distinguish the Honors group, a Dean's list of participants is compiled and published. Names of students newly eligible are also included.

THE COLLEGE OFFICES

The offices of the Dean, the Director of the Engineering Experiment Station, the Associate Dean, the Assistant Deans, and the Editor of Engineering Publications are on the first floor of Civil Engineering Hall, as is a conference room for College and Station committee meetings.

THE ENGINEERING LIBRARY

The University Library's resources for study and research are outstanding; its present collections on the Urbana campus exceed 3,000,000 volumes. In addition to the General Library, thirty-two departmental collections make specific information available at locations convenient for users. As a source of information, the Library plays an important part in the teaching and research activities of the College of Engineering. The field of technical knowledge is now so wide in scope that only a small part of the material can be covered in class instruction, and reference to the literature is an essential supplement.

The Engineering Library contains more than 65,000 volumes, including long runs of bound technical society publications, trade journals, engineering serials issued by state, federal, and foreign governments, and numerous sets of reports from research laboratories and experiment stations in this and other countries. Also, there are complete sets of the important indexes to technical periodicals, as well as abstracts and digests covering the engineering field. In addition to the Engineering Library, located in

Civil Engineering Hall, the Physics, Mathematics, Ceramics, and Chemistry Libraries are nearby and readily available to engineering students.

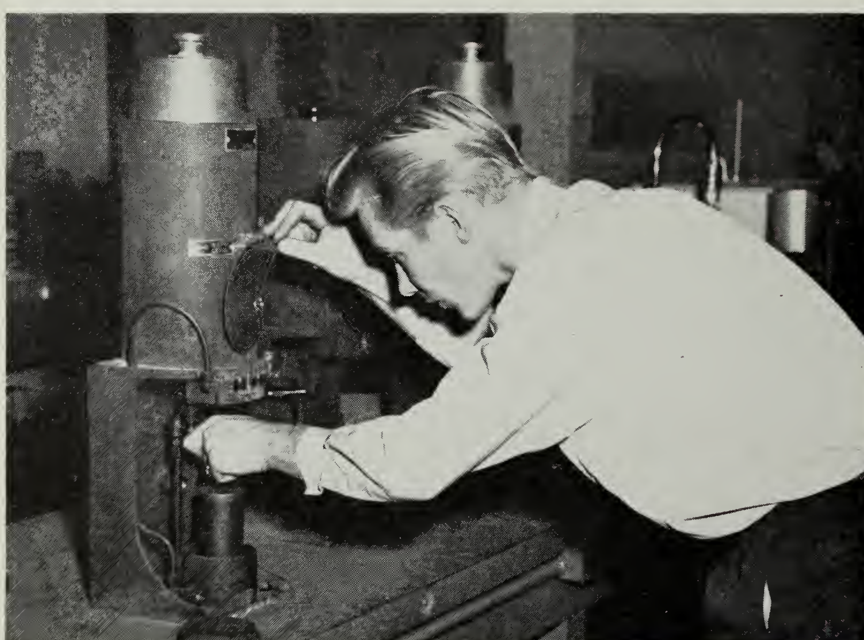
To aid in the use of reference materials, an introductory course in library science, carrying two hours of credit for freshmen and sophomores, is available as an elective. Also, the staff of the Library lectures in seminars and other courses on the use of library resources.

CHICAGO UNDERGRADUATE DIVISION

The Chicago Undergraduate Division of the University provides instruction and facilities for the first two years of engineering, as well as for liberal arts and commerce. While the work at Chicago is substantially the same as that at Urbana, and credits may be fully transferred, the Undergraduate Division is intended primarily as an aid to students who find it necessary or desirable to live in the Chicago area while they begin their attendance at the University of Illinois. Students may enroll in all engineering curricula, and can obtain nearly all of the courses for the first two years except a few specialized offerings in agricultural, ceramic, metallurgical, and mining engineering

Included in the curricula available is the joint five-year program in

Learning principles of materials quality control by tests in the cast metals laboratory of the Chicago Undergraduate Division, which offers two years of most engineering curricula.



engineering and liberal arts, which yields both degrees. Registrants in this program can complete the first two years at the Chicago Division. Courses in architecture are also presented at Chicago in the engineering division, and two and one-half years of the five-year architecture program can be completed there.

The Chicago Undergraduate Division occupies a part of Navy Pier, to which public transportation facilities are excellent from all parts of Chicago and the surrounding area. A full four-year program has been authorized for the Division and a site has been chosen for the permanent Undergraduate Division campus. Present facilities include sixty-two classrooms and seven large lecture halls, thirty-three modern, fully-equipped laboratories in chemistry, physics, geology, the biological sciences, and statistics; a welding laboratory, foundry, testing laboratory, machine-tool demonstration shop, three architecture drafting rooms, and eight engineering drawing laboratories.

The library includes nearly 100,000 volumes, subscriptions to more than 800 technical journals and magazines, thirty periodical indexing services, newspapers, a large vertical-file pamphlet collection, and excellent microfilm reading facilities. Spacious and well arranged, the library provides excellent study and reference facilities. It welcomes student use and provides a wide variety of bibliographic services.

Other services associated with an institution of college level are offered also, including a full roster of student activities, sports, and self-government. A University bookstore is conducted on a cooperative basis to provide texts and supplies required for the various courses. A food service, attractive lounges, and a large gymnasium adjoining the Pier are other features of the physical facilities.

Personnel services are provided, including quarters for such officials as the Dean of Students, Dean of Men, Dean of Women, Associate and Assistant Deans of Engineering Sciences, and Student Counseling Service. The Division maintains a student placement service in engineering to assist in finding part-time employment during the academic year as well as for the summer periods between sessions. This activity is carried on in close cooperation with the other placement services of the University.

Those interested in further information about the Chicago facilities may request the catalog of the University of Illinois Chicago Undergraduate Division. Write either to Navy Pier, Chicago, or to the Dean of Admissions and Records, University of Illinois, Urbana.

VI. REQUIREMENTS FOR ADMISSION

Entrance requirements vary somewhat among engineering colleges of the country. Basically, however, they emphasize preparation in English, mathematics, and the physical sciences. This core of essential subject matter should be supplemented by substantial preparation in social studies, natural sciences, and, if the student is interested in graduate work or foreign employment, languages.

Entrance requirements for the University of Illinois include high school graduation and at least fifteen units of subject matter, with two majors and one minor in nonvocational subjects. One of the majors must be in English.* In general, a high school unit may be considered as one year of study in a specific subject.

Three and one-half units must be in mathematics if the student is to be admitted to full freshman status in the College of Engineering at Illinois. Two units in social studies and two units in natural sciences are recommended. Preferably two of these units should be in the physical sciences (chemistry and physics). The remaining units of the fifteen offered for entrance may be from any subjects the high school accepts toward its diploma. The Dean of Admissions and Records is authorized to waive certain of the above requirements for applicants in the upper half of their graduating class.

Students may be admitted to full standing in the College of Engineering by offering the following credits and passing a placement examination in mathematics: algebra, 2 units; plane geometry, 1 unit; and trigonometry, ½ unit.

The placement examination in mathematics is given periodically. An examination schedule is available from the Dean of Admissions and Records.

Students who have not had all the mathematics stipulated may gain admission to the College of Engineering in any of four ways:

1. Provided that they satisfy the other admission requirements and have a minimum of one unit of algebra and one unit of plane geometry, students may be admitted with a deficiency in mathematics. They must

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* For admission to full status in the chemical engineering curriculum, two units of a foreign language are required, except that the Dean of Admissions and Records may waive this requirement for students in the upper half of their graduating class.

remove this deficiency during their first year in college by passing courses in the subjects in which they are deficient. Students admitted under this provision can not expect to complete the requirements for the bachelor's degree in engineering in eight semesters. It is recommended that such students enter the University in the summer session following their graduation from high school.

2. Provided that they have had one unit of algebra and one unit of plane geometry, they may study by themselves the subjects they have not taken in high school and may prepare for (a) a general placement examination in mathematics or (b) proficiency examinations in the individual mathematical subjects.

3. Provided that they have had one unit of algebra and one unit of plane geometry, they may enroll in college algebra and trigonometry courses offered by the Extension Division of the University of Illinois.* If successfully completed, these courses are accepted by the College of Engineering of the University of Illinois for credit. Successful completion of correspondence courses in college algebra and trigonometry offered

* See the University of Illinois bulletin "Correspondence Courses" for a description of course offerings, regulations, and procedures for admission. Copies are available from the Division of University Extension, 247 Illini Hall, University of Illinois, Urbana.

A student in the hydraulic engineering laboratory studying the movement of sand along the bed of the channel. Studies of this type are essential in connection with the design of irrigation and drainage channels, dams, and navigation works.

elsewhere is also acceptable, provided that these courses are taken from accredited institutions. Before enrolling in such courses, students should check first with the Dean of Admissions and Records of the University of Illinois to find whether the courses are acceptable.

4. Students who have not had at least one unit of algebra and one unit of plane geometry may take entrance examinations in these subjects and, if successful may be admitted with a deficiency in mathematics as indicated under (1) above.

Except for the required units in English and mathematics, modifications of the foregoing requirements for admission may be made in the case of students graduating in the upper half of their high school classes. These should be discussed with the Dean of Admissions and Records of the University, through whose office all admissions to the various colleges are made. Nonresidents of the state of Illinois may not be admitted if they are high school graduates in the lower half of their class.

NEW REQUIREMENTS

The general admission requirements of the University are presented in detail in the Undergraduate Study bulletin. In addition to these requirements, new entrance credit requirements have been approved by the Board of Trustees for admission to the College of Engineering at Urbana and at the Chicago Undergraduate Division. Freshmen entering the College of Engineering in the fall semester of 1963, or after, must meet these new requirements, which are:

Subject	Required Units	Recommended Additional Units
English	3	1
Algebra[1]	2	
Plane Geometry	1	
Trigonometry[1]	½	
College Preparatory Mathematics		as available
Science[2]	2	1
Social Studies	2	1
Language[3]	2	as available[4]

[1] Students who have only one unit in algebra and one unit in plane geometry may be admitted on condition that the deficiency is removed in the first year.

[2] Required science must include at least one unit each from two of the following subjects: physics, chemistry, and biology. Botany and zoology may be substituted for biology. General science may not be used as a required subject.

[3] Required language must be two units in one language. Students deficient in language may be admitted on condition that the deficiency be removed during the first two years.

[4] It is recommended that additional credit be earned in the same language that was presented for entrance credit. However, if the two required units of language are Latin, the additional credit should be in a modern language.

VII. EXTRACURRICULAR ACTIVITIES

One of the foremost questions in a student's mind often is: Why take part in professional societies and other extracurricular activities? The answer to this question is fairly simple. Important though the gaining of knowledge and the development of your mental ability are, they are not the sole aims of education. Equally important is the growth of a personality which will inspire confidence and develop friendships among your colleagues. By accomplishing this you also contribute to good citizenship in a democracy.

The question of how to develop a pleasing personality can be answered in several ways. One method, of course, is to read books on the subject and to study successful men. A generally more satisfying method, however, is to associate with your fellow students in one of the numerous available extracurricular activities.

A great many engineering students feel that they don't have enough time for activities outside of class. They say that you can't participate in these activities and still do justice to your studies. This idea is very common, but wrong. Actually, the attitudes and interests you develop by

Studying, relaxing, and discussing problems in the lounge of the Electrical Engineering Building illustrate typcial student use of facilities provided by many departments of the College.

participating in a supplementary activity help you study more effectively. This in turn more than makes up for the time you spend in the activity itself. In addition, you learn a great deal about how people's minds work; and, increasingly in your professional experience, a knowledge of human as well as material processes becomes essential. In fact, extracurricular activities provide a laboratory in human relations.

Finally, extracurricular activities give you a means of relaxing — something that nearly everyone needs. Like a hobby in later life, an extracurricular activity gives professional insight and at the same time provides a release from the strains and tensions of the day-to-day grind.

STUDENT PROFESSIONAL SOCIETIES

Every student is encouraged to take part in the activities of the student branch of his professional society. The twenty professional groups having active student branches at Illinois are:

The American Ceramic Society
The American Foundrymen's Society
The American Institute of Chemical Engineers
The American Institute of Electrical Engineers — Institute of Radio Engineers
The American Institute of Mining, Metallurgical, and Petroleum Engineers
The American Society of Agricultural Engineers
American Society of Civil Engineers
The American Society of Mechanical Engineers
The Illinois Society of General Engineers
The Illuminating Engineering Society
The Institute of Aeronautical Sciences
Institute of Traffic Engineers
The Mineral Industries Society
Mu-San (Sanitary Engineers)
The National Society of Professional Engineers
The Physics Society
The Society for the Advancement of Management
The Society of Automotive Engineers
The Society of Women Engineers
The Student Industrial Engineering Society

As you can see, most of these societies are related to a particular field of work. With slight differences, nearly all are organized to promote interest in the parent group, to advance professional spirit and ethics, and to provide a meeting place for students, faculty, and eminent practicing engineers. The monthly or biweekly meetings ordinarily have programs

Small wind tunnel used by the Theoretical and Applied Mechanics Department in studying the flow or dynamics of air as a fluid. For the study of aerodynamic shapes, the Department of Aeronautical and Astronautical Engineering also has several tunnels of various sizes, including a shock-tube installation and other ultra-high-speed devices.

Heat treatment of metals with modern equipment and controls in mechanical engineering represents also applied phases of materials analysis carried on in the metallurgy laboratories.

featuring students or prominent speakers. Most societies also sponsor picnics, smokers, and ball games throughout the year. Membership, which is entirely voluntary, should be seriously considered at any time after the first semester.

HONOR SOCIETIES

In addition to the professional societies, many departments are also represented by the following honor societies, two of which cross departmental boundaries to include all engineers:

Alpha Epsilon — Agricultural Engineering
Alpha Sigma Mu — Metallurgical Engineering
Chi Epsilon — Civil Engineering
Eta Kappa Nu — Electrical Engineering
Keramos — Ceramic Engineering
Phi Lambda Upsilon — Chemical Engineering
Pi Tau Sigma — Mechanical Engineering
Sigma Gamma Tau — Aeronautical Engineering
Sigma Tau — all-engineering
Sigma Xi — Scientific Research
Tau Beta Pi — all-engineering

Most of these have national affiliations. Since they are organized primarily to recognize and promote scholarship, members are selected by ballot and must have a minimum scholastic standing to be eligible.

THE ENGINEERING COUNCIL

The Engineering Council coordinates the activities of the professional engineering societies, promotes the interest of all engineering students in extracurricular activities, and supervises such functions as St. Pat's Ball and the Engineering Open House. The present constitution went into effect in 1947, although similar groups have been in operation since 1894. The Council consists of two representatives from each member society, plus the editor and the business manager of the *Illinois Technograph.*

THE ILLINOIS TECHNOGRAPH

One of the foremost engineering student activities is the *Illinois Technograph,* the semi-technical magazine published by the students in the College of Engineering. It began in 1886 as *Selected Papers of the Civil Engineers' Club,* and within a decade had broadened its scope to include all departments. Under its present name it underwent several changes until 1920, when operation was vested in the Illini Publishing Company, a nonprofit corporation organized to publish all of the University of Illinois student periodicals. A member of Engineering College Magazines Associated since 1923, the *Technograph* publishes eight issues each year, October through May.

The magazine has for seventy years maintained its policy of printing material prepared by the students, graduates, and, on occasion, faculty members of the College of Engineering. This policy has given the staff excellent editorial and business experience, and has proved invaluable in encouraging students to prepare technical material for presentation to societies and for later publication.

ENGINEERING OPEN HOUSE

Begun more than fifty years ago, Engineering Open House now represents a student-organized and staffed two-day presentation of exhibits, facilities, and educational information about engineering and the College. Some displays are amusing, others serious, but most are intended primarily to help orient the many thousands of high school students who attend annually. In addition, teachers, parents, and interested persons from all parts of Illinois and from adjoining states take advantage of the cordial invitation to tour the facilities and see the student activities of the College. Ordinarily Open House is held on a Friday and Saturday in mid-March; exact dates are announced in early fall for the following spring.

MISCELLANEOUS ACTIVITIES

St. Pat's Ball. The custom of holding annual engineers' dances was begun in 1910. Presently sponsored by Engineering Council, St. Pat's Ball is one of the outstanding social events for engineering students.

The *Illinois Technograph,* student magazine in engineering, offers varied opportunities both for staff work and for contributed articles.

Ordinarily held on the Saturday evening of Engineering Open House, the Ball climaxes the engineering week end. A high point in the festivities is the appearance of the patron saint to initiate into The Order of the Knights of St. Pat twelve engineering seniors outstanding in extracurricular activities.

Social Fraternities. Two fraternities on the campus are composed wholly of engineering students. These are Triangle and Sigma Phi Delta.

All-University Activities. Students of the College of Engineering take part in the great variety of activities — athletic, social, forensic, dramatic, military — open to all University of Illinois undergraduates. Many find the services and functions of the Illini Union rewarding.

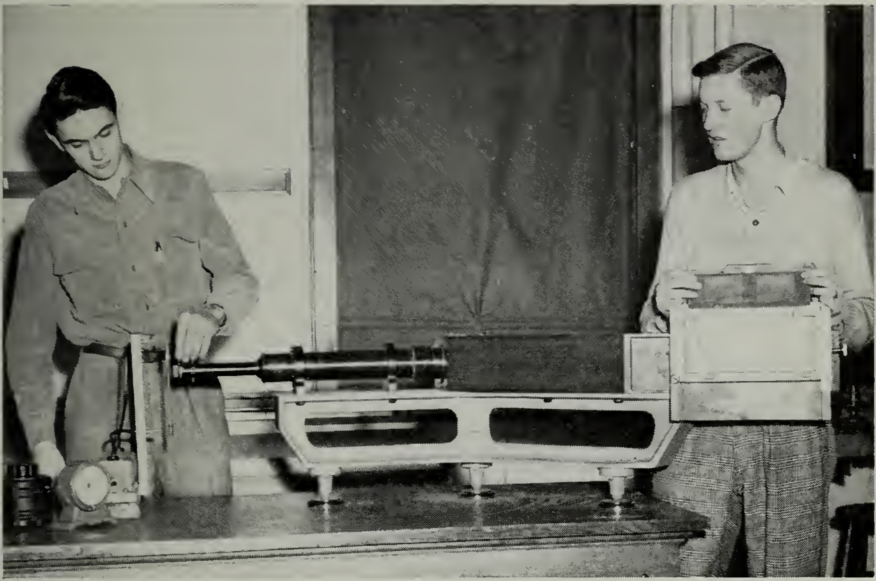
This discussion of the activities may have implied that they function under their own power. Of course they do not. Their success depends upon how well you, as a participating student, contribute your share of effort. These activities and others throughout the University will give you innumerable opportunities for reaching the social and civic part of your educational objective. Only by associating with other students and with faculty members connected with these activities can you develop the broad mental outlook and personality you'll need for a successful career and for effective citizenship.

CHICAGO UNDERGRADUATE DIVISION EXTRACURRICULAR ACTIVITIES

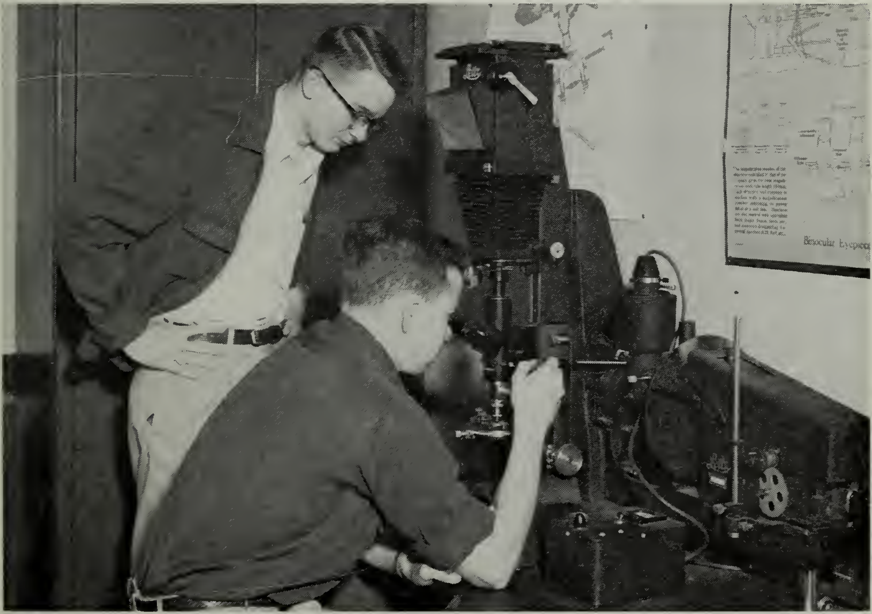
Like the colleges and departments of the University at Urbana-Champaign, the Chicago Undergraduate Division recognizes extracurricular activities as an important part of student life. Such activities are encouraged as supplements to curricular work, for their value in developing qualities of character, personality, and leadership, and for their aid in perfecting individual talents in journalism, speech and debate, music, and other fields.

Student chapters of six engineering and related societies are active: the American Society of Civil Engineers, the American Society of Mechanical Engineers, the American Institute of Chemical Engineers, American Institute of Electrical Engineers, the Institute of the Aeronautical Sciences, and the American Institute of Architects. These groups are sponsored by the senior society chapters in Chicago, and there is a high degree of mutual interest between the student and senior chapters.

Forty other student clubs and organizations are recognized at the Pier, sponsoring varied social and cultural activities for the benefit of the entire student body. In self-government, working with a faculty committee on student affairs, the Student Congress is composed of four officers and fourteen representatives elected by the student body, and has seven committees providing liaison with the faculty group.



Using advanced optical equipment in a physics laboratory.



Photomicrographic camera in ceramic engineering makes possible study of the microstructure of ceramic materials and products.

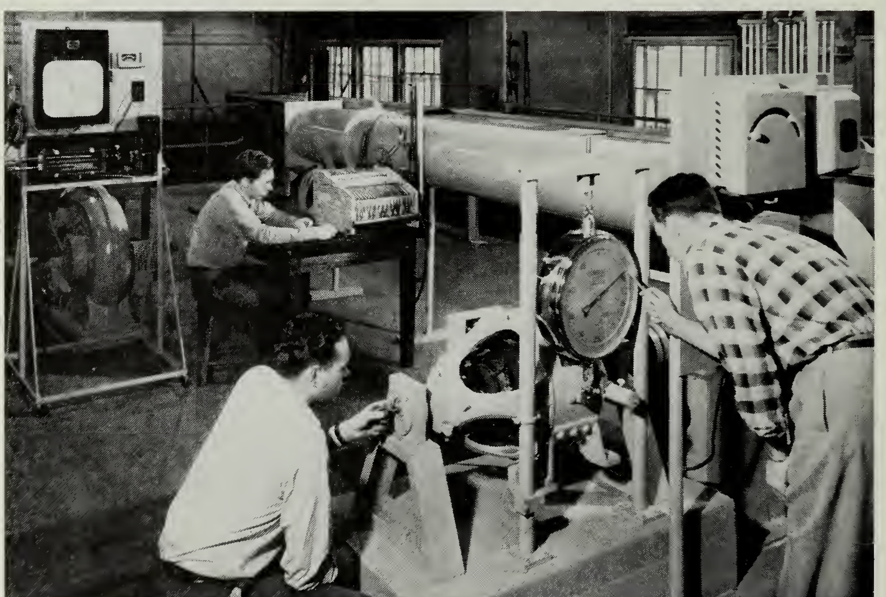
In engineering, the work of the several student chapters is coordinated by an Engineering Societies Council, which plans major technical programs, social events, and annual engineering affairs of general interest, including exhibits and dinners. Engineering students also participate in sports and contribute to the various publications, thus gaining rounded extracurricular experience.

The Chicago Undergraduate Division participates in ten varsity sports — football, basketball, baseball, cross-country running, track, wrestling, swimming, golf, gymnastics, and tennis. By special ruling, freshmen are allowed to participate in varsity sports without violating the three-year eligibility rule. All contestants, however, must meet Big Ten Conference eligibility standards.

An extensive intramural program supplements the intercollegiate sports, and includes boxing, wrestling, badminton, table tennis, volleyball, basketball, swimming, gymnastics, handball, weight lifting, tennis, track, and softball.

Experience in journalism is provided by the weekly student newspaper, the *Pier Illini,* and the yearbook; both are written and edited entirely by students. For the engineering group there is also the opportunity to write for and edit the Chicago Undergraduate Division section of the *Illinois Technograph.*

Testing air distribution in a typical mine ventilating system as a part of mining engineering study.



UNIVERSITY OF ILLINOIS
GUIDANCE INFORMATION ON ENGINEERING

FILM

"Engineering — A Career for Tomorrow" (using electrical engineering as an example, illustrates the problem-solving method of the professional engineer). Sponsored by Eta Kappa Nu; available for loan either through Engineering Alumni Committee members or from Audio-Visual Aids Service, University of Illinois. (Nominal service charge to cover transportation.)

BULLETINS

GENERAL

Guide for New Students

Mathematical Needs of Prospective Students in Engineering (1959 Revision)

Undergraduate Study (general catalog)

UNDERGRADUATE INFORMATION PRIMARILY

Careers in Mining Engineering

Ceramics — What Is It — What It Offers as a Career

Engineering Mechanics at the University of Illinois

General Engineering

Metallurgy at the University of Illinois

Steps to Your Career in Agricultural Engineering

GRADUATE EMPHASIS (but useful also at undergraduate level)

The Road to Graduate School

Engineering Mechanics at the Graduate Level

Graduate Study and Research in Civil and Sanitary Engineering

Graduate Study and Research in Electrical Engineering

Graduate Study and Research in Mechanical Engineering

Graduate Program in Nuclear Engineering, University of Illinois

The Betatron — Its Uses, Development, and Basic Operation

(Bulletins available free on request from the Dean of the College of Engineering)